

ANNEE : 1ère année / 1st year - ECTS

[EC : Data Mining - 3.00 ECTS](#)

[EC : Assembly Programming - 3.00 ECTS](#)

[EC : Image Processing - 3.00 ECTS](#)

[EC : Operating Systems - 3.00 ECTS](#)

[EC : Middleware Architectures for Ambient to Cloud Computing - 3.00 ECTS](#)

[EC : Transmission Lines and RF Systems - 3.00 ECTS](#)

[EC : Signal Processing - 3.00 ECTS](#)

[EC : Java Programming - 3.00 ECTS](#)

[EC : Wireless Communications Basics - 3.00 ECTS](#)

[EC : Computer Networks: LAN & IP Networks - 3.00 ECTS](#)

[EC : Computer Networks: Routing in the Internet - 3.0 ECTS](#)

[EC : Data Bases - 3 ECTS](#)

[EC : Research Project - 10.00 ECTS](#)

**IDENTIFICATION**CODE : IST-0-S1-EC-DBM2  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Tommasini Riccardo :  
riccardo.tommasini@insa-lyon.frM. Famà Mauro :  
mauro.fama@insa-lyon.fr**AIMS**

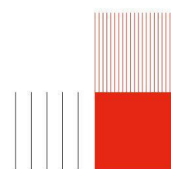
This course introduces data mining as an extension of standard database querying approaches. We motivate the need for new querying mechanisms to support data analysis and Knowledge Discovery from Databases (KDD) by means of data mining techniques. The classical data mining algorithms (clustering, classification, association rule mining) are introduced. We explain why it is interesting to study and implement such algorithms within the recent setting of constraint-based data mining. Finally, the design of data mining query languages is considered. To be concrete, the students will have to perform some practical data analysis tasks by means of the open source KNIME data mining tool. Beside the introduction of the most popular techniques, we will do our best to sketch research challenges in the area, including a discussion on the research results collected in Lyon during the last decade.

**CONTENT**

From data to knowledge: A database perspective to KDD  
Introducing the most important data mining methods  
Exploratory Data Analysis  
Clustering  
Pattern discovery  
Supervised classification  
Designing data mining query languages

**BIBLIOGRAPHY**

[1] David Hand, Heikki Mannila, Padhraic Smyth. Principles of Data Mining. MIT Press, 2001, 546 pages. Chinese translation, China Machine Press, ISBN 7-111-11577-5, 2003. [2] Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison- Wesley, 2006, 710 pages. [3] Mohammed J. Zaki, Wagner Meira Jr., Fundamentals of Data Mining Algorithms, Cambridge Press. In Press (2011). PRE-REQUISITE Basic database notions, SQL

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-ASM  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Morel Lionel :  
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guillaume.salagnac@insa-lyon.fr**AIMS**

The aim of this course is to acquire a concrete understanding of what it means to "execute" a "program" on a "computer". What is an "instruction" ? What is "a variable" ? What does "the processor" do ? What does "assembly programming" mean ? This course is neither a "computer architecture" course (we will \*not\* discuss implementation details of the hardware) nor an "operating systems" course (we will not talk about advanced topics such as virtual memory or process context switching).

**CONTENT**

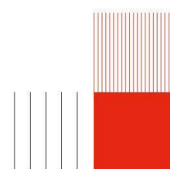
Information coding: binary numbers, hexadecimal, ascii - Binary Arithmetics: addition, subtraction, multiplication, two's complement encoding - The von Neumann Architecture: CPU+Memory, machine language vs assembly, immediates - Control Flow: control structures (loops, alternatives), mandatory vs conditional jumps, breakpoints - Addressing modes and memory instructions: direct vs indirect, indexed addressing - Memory-mapped input/output: peripheral interface through load/store - Subroutines: call protocol, return address, parameter passing, calling conventions - The Execution Stack: push/pop instructions, stack pointer, register spilling - Recursion: Application Binary Interface, fixed/caller-saved/callee-saved/scratch registers

**BIBLIOGRAPHY**

- Patterson and Hennessy, Computer Organization and Design: The Hardware/Software Interface

**PRE-REQUISITES**

High school maths: integer arithmetics, boolean logic - A laptop with Python installed (python 3.6+)



**IDENTIFICATION**

CODE : IST-0-S1-EC-SIP2  
ECTS : 3.00

**HOURS**

Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h

**ASSESSMENT METHOD**

Grading is done according to the following :  
- The image processing lab report.  
- A presentation of work on the Kaggle challenge.

**TEACHING AIDS**

All course material is published on Moodle.

**TEACHING LANGUAGE**

English

**CONTACT**

M. KECHICHIAN Razmig :  
razmig.kechichian@insa-lyon.fr

**AIMS**

This course comprises 2 modules :  
- A theoretical and practical introduction to image processing.  
- A Deep Learning workshop.

**CONTENT**

- Digital image representation (spatial and frequency domains), notions of neighborhood, sampling, quantization etc.
- Image processing : histogram operations, linear operations (denoising, edge detection etc.), non-linear operations and mathematical morphology.
- Image segmentation : histogram, contour and region based approaches.
- Image processing lab applied to previous points.
- Introduction to deep learning via convolutional neural networks tutorial lab.
- Application of deep learning to a Kaggle challenge.

**BIBLIOGRAPHY**

- Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 3rd edition, Pearson, 2007
- Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016, <https://www.deeplearningbook.org/>

**PRE-REQUISITES**

Good background in applied math and digital signal processing is necessary, e.g. the SIP1 module, in addition basic Python programming skills.

**IDENTIFICATION**CODE : IST-0-S1-EC-OPS  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Salagnac Guillaume :  
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The aim of the course is to present the fundamental concepts and issues in the topic of operating Systems. We will first take a short historical tour of computer systems and discuss why operating systems were introduced. We will then describe the major components and abstractions of a general-purpose OS. Finally, we will address the programming interfaces of many operating systems based on processes, various interprocess communication techniques and scheduling of processes.

**CONTENT**

- using the unix command line: terminal, shell, commands, files vs directories, ls, cd, mkdir, cp, mv, rm - compiling and debugging a C program: gcc=c++cc+as+ld, objdump, gdb, breakpoints, single-stepping, examining memory. - introduction to the C language: syntax, variables, types, control structures (if, for, while), functions, formatted output with printf - arrays and pointers: pointers and addresses, arrays, strings, passing command-line arguments to your programs - processes, kernel and system calls, userland, processes - file input/output: file descriptors, open/close/read/write syscalls, stdio streams, fopen/fgets/ etc, buffering - memory allocation: static vs dynamic, globals / stack / heap, malloc, structured data types, linked lists

**BIBLIOGRAPHY**

[1] Operating System Concepts Essentials, A. Silberschatz P. Galvin and G. Gagne, Wiley. [2] The C Language. Brian W. Kernighan, Dennis M. Ritchie. [3] Computer Organization and Design. David Patterson, John L. Hennessy. PRE-REQUISITE - Computer architecture: registers vs ALU, CPU vs bus vs memory, the Von Neumann cycle, address space vs memory size, hexadecimal notation and powers of two. - Computer programming: control flow and variables, functions, loops, simple data structures such as arrays and linked lists. - C language: write, run and debug simple programs on linux. design data structures including pointer fields, strings.

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-MID  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Le Mouél Frédéric :  
frederic.le-mouel@insa-lyon.fr**AIMS**

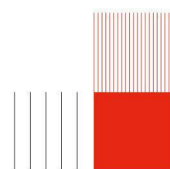
This course focuses on the design and implementation of common middleware families as found in real-world distributed application architectures. We tackle the challenges addressed by middleware design through both the prism of classical distributed systems problems as well as the techniques used to simplify programming models. Students will acquire useful knowledge in the age of cloud computing as a target of choice for building innovative products. Indeed, they will understand key elements in the design of popular frameworks, and they will learn about the common pitfalls of distributed systems.

**CONTENT**

\* Introduction \* Concurrent programming \* Lock-free concurrent programming \* Aspect-oriented programming \* Component container design and usage \* Comparing distributed events with logical and vector clocks \* Consensus algorithms

**BIBLIOGRAPHY**

[1] Andrew S Tanenbaum, "Distributed Operating Systems", Prentice-Hall [2] Sape Mullender, "Distributed Systems", Addison-Wesley [3] Clemens Szyperski with Dominik Gruntz and Stephan Murer, "Component-Software Beyond Object-Oriented Programming" [4] Richard Monson-Haefel, "Enterprise JavaBeans", O'Reilly [5] Gregor Hoppe, Bobby Woolf, "Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions", Addison-Wesley PRE-REQUISITE Java, networks, operating systems

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-TLRS  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Hutu Florin :  
florin-doru.hutu@insa-lyon.fr**AIMS**

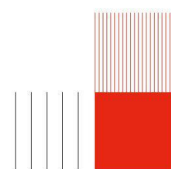
Knowledge about high frequency systems. Choice of right transmission line considering applications. Matching circuit design. RF simulation tools. Basic principles of transmission lines. Comprehensive study of high frequency propagation and standing waves. Knowledge about matching circuits and applications. Different kinds of transmission lines. Link with the wireless propagation domain.

**CONTENT**

Telegraphist Equations - Reflection Coefficient - Standing Waves - Impedance Matching - Smith Chart - S parameters

**BIBLIOGRAPHY**

[1] Brian C. Wadell, Transmission Line Design Handbook (Artech House), 1991 [2] Philip C. Magnusson, Andreas Weisshaar, Vijai K. Tripathi, Gerald C. Alexander, Transmission Lines and Wave Propagation, Fourth Edition, CRC Press, 2000 PRE-REQUISITE Good basis in mathematics

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-SIP1  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Merveille Odyssée :  
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The course introduces the fundamentals of signal processing. Signals and systems are studied both in time and frequency domains. Linear and Time Invariant Systems are analyzed through their impulse and frequency responses and their transfer function. Skills: To model, analyze and characterize in time and frequency.

**CONTENT**

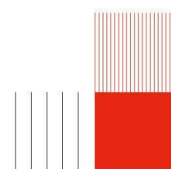
- General signal and system properties - Linear Time Invariant Systems and convolution  
- Fourier Series, Fourier Transform: in continuous time and in discrete time - Time and frequency characterization of signals and systems - Sampling - Several labs will allow to get familiar with Matlab, to process various signals and to analyze them in time and frequency.

**BIBLIOGRAPHY**

[1] Alan V. Oppenheim, Ronald T. Schafer, Ronald W. Schafer, Wayne T. Padgett, Discrete-Time Signal Processing, Prentice Hall, ISBN 0131988425, 1108 p., 2009. [2] Bernard Mulgrew, Peter M. Grant, John Thompson, John Thompson, Digital Signal Processing: concepts and applications, Palgrave Macmillan, ISBN 0333963563, 380 page, 2003.

**PRE-REQUISITES**

B.Sc. standard level in mathematics, esp. Function analysis, Series, Differential and integral calculus Basic programming skills





**IDENTIFICATION**CODE : IST-0-S1-EC-JAV  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Le Mouél Frédéric :  
frederic.le-mouel@insa-lyon.fr**AIMS**

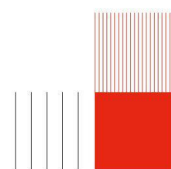
The aim of the course is to learn java programming. After a brief 2h general introduction, the work is done directly on computers. The course is structured in lectures that span the Java programming language and the virtual machine. The course is illustrated by practical sessions. Skills - Programming skills - Understanding Object philosophy as a design tool - Rapid integration of on-line documentation - Debugging skills

**CONTENT**

- General presentation of Java and object oriented language - Object and Classes - Virtual Machine and running java applications - Methods and class structure - Exceptions and Classpath - Inheritance and Interfaces - Data Structures with java - Input/Output - Multi-threaded applications - Graphical User-Interfaces - Applets

**BIBLIOGRAPHY**

[1] Exploring Java 2nd edition, P. Niemeyer et J. Peck, Addison Wesley, 1997 [2] Effective Java, Guy L., Jr. Steele, Joshua Bloch, et Josh Bloch, Addison-Wesley, 2003  
PRE-REQUISITE Algorithmic principles : assignments, loops, conditions, recursion. Programming basics in another language.

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-WCB  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Villemaud Guillaume :  
guillaume.villemaud@insa-lyon.fr**AIMS**

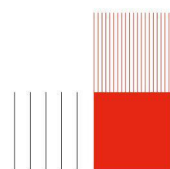
This course focuses on wireless transmissions basics. Starting from results from Maxwell's equations, the principles of radiated fields are exposed. Common characteristics of antennas are detailed, and the main families of antenna structures (wired, patch, horn, reflectors, arrays) are exposed considering possible applications. The purpose is also to be able to establish a budget link of a radio transmission and to open on more advanced techniques which can enhance wireless systems performance.

**CONTENT**

- Transmission chain - Radio channel - Elementary doublet - Reciprocity, image theory, theorem of Babinet - Antenna parameters: input impedance, bandwidth, directivity and gain - Radiation pattern - Budget link - Wired antennas - Slot antennas - Patch antennas - Horns - Reflectors - Antenna arrays

**BIBLIOGRAPHY**

[1] J.M. Laheurte, Compact Antennas for Wireless Communications and Terminals: Theory and Design, Wiley, 2011 [2] J.D. Kraus, Antennas, Mc Graw Hill, 2001 [3] C. A. Balanis, Antenna Theory: Analysis and Design, 3rd Edition, Wiley  
PRE-REQUISITE  
Basis of electromagnetism and transmission lines.

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-NET1  
ECTS : 3.00**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Boubrima Ahmed :  
ahmed.boubrima@insa-lyon.fr**AIMS**

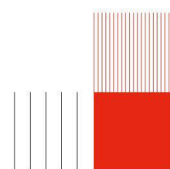
The main objective of this course is to understand the basic mechanisms of IP networks, both over Ethernet and 802.11 networks. After a general introduction to networking principles, we will introduce the classical OSI Network Stack as a comprehensive understanding to networking protocols and architectures. Medium Access Control protocols will be considered for wired and wireless environment: Ethernet (802.3) and Wi-Fi (802.11) will be discussed in depth. We will focus the main part of this course on TCP/IP (Data Link and IP - Communication over IP - Transport layer UDP/TCP - IP addressing and basic routing - Advanced Networking, Filters and VPN - C networking programming).

**CONTENT**

- Introduction to networking - Fundamentals of local networking (IEEE 802.11, 802.3) - Data Link and IP networks - Addressing and routing - Transport protocols (TCP, UDP) - Introduction to networking programming

**BIBLIOGRAPHY**

[1] TCP/IP Illustrated, Volume 1: The Protocols, W. R. Stevens, Addison Wesley [2] TCP/IP Illustrated, Volume 2: The Implementation, W. R. Stevens, Addison Wesley [3] The IEEE 802.11 Handbook: A Designer's Companion, B. O'hara, A. Petrick, Institute of Electric & Electronic Engineers. [4] Computer Networking: A Top-Down Approach: International Version, J. F. Kurose, K. W. Ross, Pearson Education. [4] Ad Hoc Mobile Wireless Networks: Protocols & Systems, C. K. Toh, Prentice Hall. [5] VANET: vehicular applications and inter-networking technologies, H. Hartenstein, K. Laberteaux, Wiley. PRE-REQUISITE Basic networking. Wireless networks are not pre-requisite but are recommended.

**PRE-REQUISITES**

**IDENTIFICATION**CODE : IST-0-S1-EC-NET2  
ECTS : 3.0**HOURS**Cours : 8h  
TD : 2h  
TP : 8h  
Projet : 0h  
Evaluation : 2h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD**

A one hour written exam.

**TEACHING AIDS**

All class materials are available on Moodle.

**TEACHING LANGUAGE**

English

**CONTACT**Mme Iova Oana :  
oana.iova@insa-lyon.fr**AIMS**

This course presents the routing protocols, the principles and associated algorithms and their implementation in network architectures.

Learning outcome:

- Configure active elements (switch, router) of a network in LAN and WAN elementary architectures

- Implement network routing across the Internet

- Implement routing of IPv6, RIPng and OSPFv4 networks

Professional skills developed:

- Principles of IP routing and associated algorithms Bellman Ford, Dijkstra

- Internal routing protocols RIP, OSPF

In addition, it requires the following professional skills:

- Specify, design and model communication networks and protocols

- Implement, implement, develop, deploy systems for transmission and processing of signals / images / data

- Interact with others, work in a team

**CONTENT**

1. Introduction to IPv6.
2. Course and laboratory work on interior gateway protocols RIP and OSPF.
3. Course on the exterior gateway protocol BGP.

**BIBLIOGRAPHY**

O. Bonaventure, "Computer Networking: Principles, Protocols and Practice"

A. Tanenbaum, "Computer Networks"

J. Kurose, K. Ross, "Computer Networking a Top-Down Approach"

Cisco Academy

RFCs

**PRE-REQUISITES**

This course treats the different routing protocols used in the Internet: interior (RIP, OSPF), exterior (BGP). A previous knowledge on networking fundamentals is mandatory: understanding of IPv4 networks, OSI/TCP-IP models, and basic network configuration.

**IDENTIFICATION**CODE : IST-0-S1-EC-DBM1  
ECTS : 3**HOURS**Cours : 0h  
TD : 20h  
TP : 0h  
Projet : 0h  
Evaluation : 0h  
Face à face pédagogique : 20h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD**

- Small project (with 4 hours of assistance) on computers
- 2 hours of presentation of the project by the students

**TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Tommasini Riccardo :  
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This course introduces the most important concepts concerning the design and the use of databases. It covers the main issues in data modeling when considering the relational data model (structure, languages like relational algebra and relational calculus) and the key features of attribute-oriented models with respect to constructor-oriented models (like, for instance, Extended Entity-Relationship models). The fundamental concepts like the constraints and the normal forms will be explained and their impact on the quality of designed databases will be discussed. Finally, practical aspects of relational database design and use will be discussed. It includes a presentation of the SQL query language but also a short introduction to data warehousing and On Line Analytical Processing queries (OLAP). To be concrete, the students will have to understand the design of a real relational database and to practice database querying with a professional DataBase Management System (DBMS).

**CONTENT**

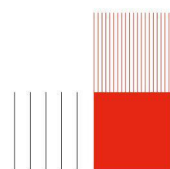
Introduction to data models and application to databases  
Studying the relational data model  
Structure  
Languages  
Constraints  
Introducing database design  
Using the Extended Entity-Relationship Model  
Normals forms and data dependencies  
Practical issues  
Using SQL  
Introducing Data Warehousing.

**BIBLIOGRAPHY**

Heikki Mannila and Kari-Jouko Raiha. The Design of Relational Databases, 2nd Edition, 1994, Addison-Wesley.  
Serge Abiteboul, Rick Hull, Victor Vianu, Foundations of databases, 685 pages, 1995, Addison-Wesley  
Carlo Batani, Stefano Ceri, Shamkant B. Navathe. Conceptual Database Design: An Entity-Relationship Approach. 455 pages. Benjamin/Cummings.

**PRE-REQUISITES**

Set theory, basic notions in discrete mathematics and algorithms.



**IDENTIFICATION**CODE : IST-0-S1-EC-REP  
ECTS : 10.00**HOURS**Cours : 0h  
TD : 0h  
TP : 0h  
Projet : 20h  
Evaluation : 0h  
Face à face pédagogique : 0h  
Travail personnel : 0h  
Total : 20h**ASSESSMENT METHOD****TEACHING AIDS****TEACHING LANGUAGE**

English

**CONTACT**M. Risset Tanguy :  
Tanguy.Risset@insa-lyon.fr**AIMS**

This project is a technical R&D project where the student has a lot of freedom to lead the project. The student will work on the project throughout the whole semester. A technical project means a final prototype which can be technological, software or a study.

**CONTENT**

The project can be done alone or by 2 students. The projects take place in an INSA lab, such as CITI, CREATIS, or LIRIS. Students need to work 100 to 150 hours on the project.

**BIBLIOGRAPHY****PRE-REQUISITES**