INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

SCIENCE, TECHNOLOGY, HEALTH

MASTER COMPUTER AND NETWORKS ENGINEERING

Engineering sciences

Targeted level of education
BAC+5

Duration
2 années

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Introducing

Objectives

The Computer and Network engineering course focuses on the concepts, methods and techniques of signal processing, electronics, and computer science in order to look further, in the final year, into the more specific components of the specialization: telecommunications, networks and distributed computing. It provides Cross-disciplinary competences: capacity to manage the economic, financial, human, organisational and technical aspects of a project in the sphere of activity of a generalist engineer for the: Design of Network Architecture and Protocols, Implementation and Administration of computer networks, taking into account Safety constraints: local and long distance networks, network connections, A.T.M, TCP/IP Definition of hardware or software configuration based on the concepts of software engineering, coding, filtering: modulation, signal emission and reception of a network interface, software applications, client-server applications, Web applications, Design of software and circuits for telecommunications: communication protocols, optical communications, terrestrial and satellite radio-communications, real-time applications. In addition to the general competences of network-telecommunications engineers able to work in all sectors of activity, the course provides in-depth study of more specific topics such as: formal design and programming of distributed systems telecommunications and networks and either: Multimedia/Internet applications Embedded Electronics telecommunications.

Admissions

Access conditions

Diplôme d'ingénieur habilité par la commission des titres d'ingénieur, 5 années d'études après la fin des études secondaires, confère le grade de Master. Baccalauréat ou équivalent pour une admission en première année Admission sur titre possible en année 2, 3 ou 4. Admission A tous les niveaux, l'admission aux INSA s'effectue par concours sur titres, dossier et éventuellement entretien ; le dossier rassemble des éléments d'évaluation obtenus par ailleurs par le candidat.

Target audience

Necessary prerequisites

Recommended prerequisites

Practical info

Location(s)

Toulouse

Program

FOUTH YEAR – IR

4th YEAR COMPUTER AND NETWORKS ENGINEERING

SEMESTER 7_4th YEAR IR

4th YEAR IR INSA_SEMESTER 7

SEMESTER 7_4th YEAR IR
ORIENTATION SI

OPTION CSH or IAE

Liste d'éléments pédagogiques

Improve your management abilities	4 crédits	45h

Toulouse School of Management

Liste d'éléments pédagogiques

Fundamentals in Computer Science	7 crédits	72h
Hardware Computing µcontrollers	4 crédits	
Internet and Security	5 crédits	
Object Oriented Design and Object Oriented Programming	6 crédits	85h
Improving one's autonomy and building one's own professional project level 2 S7	4 crédits	46h
French I	3 crédits	
Political sciences semester 1	3 crédits	

SEMESTER 7_4th YEAR IR
ORIENTATION SC

OPTION CSH or IAE

Liste d'éléments pédagogiques

Improve your management abilities	4 crédits	45h

Toulouse School of Management

Liste d'éléments pédagogiques

Mobiles networks and wireless networks	6 crédits	55h
[FRANCAIS] Systèmes de transmission	5 crédits	68h
Internet and Security	5 crédits	
Object Oriented Design and Object Oriented Programming	6 crédits	85h
French I	3 crédits	
Improving one's autonomy and building one's own professional project level 2 S7	4 crédits	46h
Political sciences semester 1	3 crédits	

CHALLENGE BASED LEARNING
_SEMESTER 1

Liste d'éléments pédagogiques

[FRANCAIS] Challenge – Formation ECIU	1 crédits	
[FRANCAIS] Challenge – Formation ECIU	2 crédits	
[FRANCAIS] Challenge – Formation ECIU	3 crédits	
[FRANCAIS] Challenge – Formation ECIU	4 crédits	
[FRANCAIS] Challenge – Formation ECIU	5 crédits	

SEMESTER 8_4th YEAR IR

4th YEAR IR INSA_SEMESTER 8

SEMESTER 8_ 4th YEAR IR ORIENTATION SI

Liste d'éléments pédagogiques

Logic and problem solving artificial intelligence	4 crédits	
Software and hardware architecture for computer systems	6 crédits	65h
Concurrent and real time system	4 crédits	53h
Research Initiating Project	4 crédits	37h
[FRANCAIS] Machine Learning	2 crédits	
QSE , APS 2	4 crédits	38h
Communication in organisations with LV2	6 crédits	
French II	3 crédits	
Political sciences semestre 2	3 crédits	

SEMESTER 8_ 4th YEAR IR ORIENTATION SC

Liste d'éléments pédagogiques

Advanced interconnection and long distance networks	7 crédits	103h
Architecture of telecommunication systems	3 crédits	41h
Concurrent and real time system	4 crédits	53h
Research Initiating Project	4 crédits	37h
[FRANCAIS] Machine Learning	2 crédits	
French II	3 crédits	
Communication in organisations with LV2	6 crédits	
Communication in organisations	6 crédits	42h
QSE , APS 2	4 crédits	38h
Political sciences semestre 2	3 crédits	

CHALLENGE BASED LEARNING _SEMESTER 2

Liste d'éléments pédagogiques

[FRANCAIS] Challenge – Formation ECIU	1 crédits	
[FRANCAIS] Challenge – Formation ECIU	2 crédits	

[FRANCAIS] Challenge – Formation ECIU	3 crédits	
[FRANCAIS] Challenge – Formation ECIU	4 crédits	
[FRANCAIS] Challenge – Formation ECIU	5 crédits	

FORMATION CONTINUE CT1 COMPUTER AND NETWORKS ENGINEERING

SEMESTER 7_CT1 IR

SEMESTER 7_4th YEAR IR
ORIENTATION SC

OPTION CSH or IAE

Liste d'éléments pédagogiques

Improve your management abilities	4 crédits	45h

Toulouse School of Management

Liste d'éléments pédagogiques

Mobiles networks and wireless networks	6 crédits	55h
[FRANCAIS] Systèmes de transmission	5 crédits	68h
Internet and Security	5 crédits	
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French I	3 crédits	
Improving one's autonomy and building one's own professional project level 2 S7	4 crédits	46h
Political sciences semester 1	3 crédits	

SEMESTER 7_4th YEAR IR
ORIENTATION SI

OPTION CSH or IAE

Liste d'éléments pédagogiques

Improve your management abilities	4 crédits	45h

Toulouse School of Management

Liste d'éléments pédagogiques

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French I	3 crédits	
Political sciences semester 1	3 crédits	

SEMESTER 8_CT1 IR

SEMESTER 8_ 4th YEAR IR
ORIENTATION SC

Liste d'éléments pédagogiques

Advanced interconnection and long distance networks	7 crédits	103h
Architecture of telecommunication systems	3 crédits	41h
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SEMESTER 8_ 4th YEAR IR
ORIENTATION SI

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French II	3 crédits	
Political sciences semestre 2	3 crédits	

FIFTH YEAR – IR
5th YEAR COMPUTER AND NETWORKS ENGINEERING

SEMESTER 9_5th YEAR IR

5th YEAR IR INSA_SEMESTRE 9

5th YEAR IR_ORIENTATION SDBD

5th YEAR GEI CHOIX OPTIONNEL MINEURE

Liste d'éléments pédagogiques

Prescriptive Analytics	4 crédits	
Software Defined Communication Infrastructure	4 crédits	
Cloud Computing	6 crédits	69h
Model driven engineering	6 crédits	
Modeling, evaluation and optimisation of networks and protocols	4 crédits	78h

[FRANCAIS] Commande avancée et supervision	6 crédits	
Projet physique PTP_ISS	4 crédits	
Service Robotics	6 crédits	50h

Liste d'éléments pédagogiques

Software engineering and service oriented architectures	4 crédits	41h
Reliability and model-checking	4 crédits	42h
[FRANCAIS] Analyse descriptive et prédictive	4 crédits	56h
Infrastructure for massive data processing	4 crédits	61h
[FRANCAIS] Projet SDBD	4 crédits	52h
Human relations	6 crédits	78h
Module élève ingénieur (UE PETAR dispensée UPS)	4 crédits	

5th YEAR AE_THEME SIEC

5th YEAR GEI CHOIX OPTIONNEL MINEURE

Liste d'éléments pédagogiques

Prescriptive Analytics	4 crédits	
Software Defined Communication Infrastructure	4 crédits	
Cloud Computing	6 crédits	69h
Model driven engineering	6 crédits	
Modeling, evaluation and optimisation of networks and protocols	4 crédits	78h
[FRANCAIS] Commande avancée et supervision	6 crédits	
Projet physique PTP_ISS	4 crédits	
Service Robotics	6 crédits	50h

Liste d'éléments pédagogiques

Human relations	6 crédits	78h
Embedded Computer Architecture	4 crédits	
Engineering methods	4 crédits	42h
Dependability	5 crédits	68h
Interdisciplinary Project	5 crédits	

5th YEAR THEME SECURITY

Liste d'éléments pédagogiques

Security fundamentals	5 crédits	77h
Software security	4 crédits	47h
System security, hardware security and reverse	4 crédits	54h
Networks and protocols security	3 crédits	40h
Architectures of secured networks	4 crédits	54h
[FRANCAIS] Sécurité des systèmes embarqués critiques	5 crédits	31h
[FRANCAIS] SHSJ	5 crédits	42h

[FRANCAIS] UE commune M2 RT	9 crédits	45h

5th YEAR THEME INNOVATIVE SMART SYSTEM

Liste d'éléments pédagogiques

Smart Devices	5 crédits	
Communication	5 crédits	
Middleware and services	5 crédits	62h
Analysis and data processing, business applications	4 crédits	37h
Innovative project	5 crédits	76h
Innovation and humanity	6 crédits	76h

5th YEAR THEME RISK ENGINEERING

Liste d'éléments pédagogiques

Qualitative Approach	4 crédits	45h
Quantitative Approach	5 crédits	45h
Designing for safety	5 crédits	42h
Process Safety	5 crédits	45h
Functional Safety		
[FRANCAIS] Structural Safety		
Human relations	6 crédits	78h
Toxic risks	5 crédits	42h

5th YEAR THEME ENERGY

OPTION THEME ENERGY _SEMESTER 9

Liste d'éléments pédagogiques

Energy production from renewable resources	5 crédits	32h
Technologies and architectures for the conversion and storage of electrical energy	5 crédits	47h
Innovative materials for the energy	5 crédits	15h

Liste d'éléments pédagogiques

Combination of multi-sources of energy platform	9 crédits	161h
The different generation technologies and energy management	5 crédits	7h
Human relations	6 crédits	78h

CHALLENGE BASED LEARNING _SEMESTER 1

Liste d'éléments pédagogiques

[FRANCAIS] Challenge – Formation ECIU	1 crédits	
[FRANCAIS] Challenge – Formation ECIU	2 crédits	
[FRANCAIS] Challenge –	3 crédits	

[FRANCAIS] Challenge – Formation ECIU	4 crédits	
[FRANCAIS] Challenge – Formation ECIU	5 crédits	

SEMESTER 10_5th YEAR IR

Liste d'éléments pédagogiques

Training period 4th year	9 crédits	
[FRANCAIS] Projet Long N7	8 crédits	
Training period 5th year	21 crédits	
[FRANCAIS] Stage PFE N7	22 crédits	

FORMATION CONTINUE CT2 COMPUTER AND NETWORKS ENGINEERING

SEMESTER 9_CT2 IR

5th YEAR IR_ORIENTATION SIEC

5th YEAR GEI CHOIX OPTIONNEL MINEURE

Liste d'éléments pédagogiques

Prescriptive Analytics	4 crédits	
Software Defined Communication Infrastructure	4 crédits	
Cloud Computing	6 crédits	69h
Model driven engineering	6 crédits	
Modeling, evaluation and optimisation of networks and protocols	4 crédits	78h
[FRANCAIS] Commande avancée et supervision	6 crédits	
Projet physique PTP_ISS	4 crédits	
Service Robotics	6 crédits	50h

Liste d'éléments pédagogiques

Engineering methods	4 crédits	42h
Embedded Computer Architecture	4 crédits	
Human relations	6 crédits	78h
Interdisciplinary Project	5 crédits	
Dependability	5 crédits	68h

5th YEAR THEME SECURITY

Liste d'éléments pédagogiques

Security fundamentals	5 crédits	77h
Software security	4 crédits	47h
System security, hardware security and reverse	4 crédits	54h
Networks and protocols security	3 crédits	40h
Architectures of secured networks	4 crédits	54h
[FRANCAIS] Sécurité des systèmes embarqués critiques	5 crédits	31h

[FRANCAIS] SHSJ	5 crédits	42h
[FRANCAIS] UE commune M2 RT	9 crédits	45h

SEMESTER 10_CT2 IR

Liste d'éléments pédagogiques

Training period 4th year	9 crédits
Training period 5th year	21 crédits

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

Objectives

At the end of this module, the student will

¿ Know the legal environment and responsibilities of a business
activity
¿ Be able to objectively assess the financial health of a company and evaluate the rentability of an investment
¿ Realize a market diagnosis (benchmarking) and a business diagnosis in order to make decisions and set goals and strategies
¿ Collect the market data and put in action a business plan adapted to the means and goals of the company
Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied Chinese, German, Spanish ¿ and the level of the student.

They can be consulted on :

https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Fundamentals in Computer Science

ECTS
7 crédits

Hourly volume
72h

Introducing

Objectives

This course is heterogeneous course and groups 3 parts :
- Functionnal Programming ¿ Caml (¿FP- Caml¿)
- Formal Logic and Logic Programming in Prolog (¿FL- Prolog¿)
- Advanced Algorithmics (« AA »)
At the end of this module, students are expected to :

[FP-Caml]
- understand and write pure functional programs,
- design recursive functions to iterate over recursive data types,
- define variants or parameterized types,
- more generally think in terms of higher-order functions
in order to write reusable codes.
- describe the semantics of simple lambda terms
- have a basic theoretical understanding of the type systems theory

[FL-Prolog part]
- translate natural language statements into formulas of
propositional logic and of 1st order predicate calculus
- apply several methods in order to check the validity and
the consistency of a formula
- explain the fundamentals of logic programming and of
Prolog.
- express problem solving as a demonstration (proof) based on axioms and theorems describing the particular
properties of the problem.
- design a Prolog program and trace its execution

[AA Part]
Some paradigms in algorithmics for discrete optimization :
- Exhaustive enumeration
- Divide and Conquer
- Dynamic Programming
- Greedy Algorithms

Practical info

Location(s)

Toulouse

Hardware Computing µcontrollers

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
o Programming specificities of the peripheral units for microcontroller.
o How to take into account hardware constraints for the design of embedded system.

The student will be able to:
o To select an architecture processor adapted to the software application and to the process configuration.
o To conceive and test the techniques of the programming by hardware interruption.
o To use debug tools and test in the context of crossdevelopment.
o To find information into datasheet.

Necessary prerequisites

I2MAIF11 : Informatique matérielle Electronique numérique
I3MAIF22 : Langage dassemblag

Practical info

Location(s)

Toulouse

Internet and Security

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Network interconnection part:
o the basic concepts and techniques allowing interconnecting local area networks in the Internet: repeater, bridge, router
o the basic concepts and techniques allowing interconnecting LAN in the Internet : subnetting, CIDR, VLAN, VPN, applicative proxy, NAT
o the main protocols of the TCP/IP Internet architecture : UDP, TCP, IP, ARP/proxy ARP, ICMP, DHCP (Note : RIP, OSPF and BGP are briefly introduced).

- Distributed algorithm part:
o principal characteristics of the distributed systems (asynchronism, distribution of control and the data, absence of common knowledge, dynamicity,¿),
o their specific problems and the difficulty of their solution in a distributed context (mutual exclusion, management of the shared data, distributed choice, diffusion, detection of the termination,¿),
o some generic algorithmic tools allowing to solve them: causality, distributed recursivity (waves) and distributed iteration (phases), specific topological structures.

- Security part:
o principles of computer security through the properties that characterize it as well as the classification of the major threats and the corresponding countermeasures,
o main vulnerabilities of computer networks, in particular the Internet network as well as the corresponding countermeasures,
o main software vulnerabilities as well as some countermeasures.

The student will be able to:
- Network Interconnection part:
o do architecture choices allowing to take into account requirements and constraints associated to a LAN interconnection,
o do basic or complex addressing and routing schemas,
o set up (administrate) Ethernet and IP networks in the basic and advanced interconnection contexts considered in the course.

- Distributed algorithm part:
o solve generic problems involved in the implementation of systems distributed
o handle the most general tools allowing to conceptualize them.

- Security part:
o analyse a computer network and its software in order to identify the main vulnerabilities, from software and network point of view and to propose corresponding countermeasures to improve the security of the whole system.

Necessary prerequisites

Course Introduction to computer networks (3MIC)
Cours de programmation distribuée dans les réseaux (socket API) (3MIC)

Practical info

Location(s)

Toulouse

Object Oriented Design and Object Oriented Programming

ECTS
6 crédits

Hourly volume
85h

Introducing

Objectives

At the end of this module, the student will understandd and be able to explain (main concepts):
Object oriented application design based on the UML language, and the
object oriented programming (Java language)

The student will be able to:
* Master object theory and the UML design modelling language
* Master a design methodology based on use cases and integrating detailed analysis and design phases.
* Apply the object concepts and a design methodology using the JAVA language
* Understand the advantages of following best practices guidelines provided by the use of design patterns
* Configure and use the configuration management tools (e.g. Git, Maven, etc.)
* Explore the use of standard documents for project management, requirements specification, software design and software tests.
* Configure and use collaborative workspaces applied to the software development process (e.g., JIRA).
* Have an initial experience to the project management challenges in a software development process project.
* Plan and play designer and developer roles within a software development process.

Necessary prerequisites

Structured programming (ADA, C, Pascal, etc)
Object-oriented programming (basic)

Practical info

Location(s)

Toulouse

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

French I

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

Objectives

At the end of this module, the student will

¿ Know the legal environment and responsibilities of a business
activity
¿ Be able to objectively assess the financial health of a company and evaluate the rentability of an investment
¿ Realize a market diagnosis (benchmarking) and a business diagnosis in order to make decisions and set goals and strategies
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Module L 2
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In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Mobiles networks and wireless networks

ECTS
6 crédits

Hourly volume
55h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
Mobile networks and wireless networks functioning and deployment principles and their communication and network architecture

The student will be able to:
-understand the cellular architecture of mobile and wireless
networks
-design and deploy a mobile cellular network
-handle the communication and network architecture of mobile networks, the roaming and handover principles
-master the radio access network (RAN) and its impact on
the design of the whole network architecture
-understand the information transmission (voice, data, multimedia) in mobile and wireless network
-understand the energy management and the principles to
adapt the emission power in wireless and mobiles networks
-identify the specificity of wireless local and personal networks and their effects on the network architecture
-handle the main functioning principles of local and personal wireless networks
-design and deploy an enterprise local wireless network

Necessary prerequisites

Telecommunication and Network classes

Practical info

Location(s)

Toulouse

[FRANCAIS] Systèmes de transmission

ECTS
5 crédits

Hourly volume
68h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- How the properties and limitations of channels influence transmission
- The different perturbation sources
- The properties of most antennas
- Modulation and demodulation techniques
- Coding and error-correction techniques.

The student will be able to:
- Identify the limitations of a channel and how they alter the signal
- Build a model of a transmission channel, so as to conceive an adapted and optimized transmission link
- Dimension an antenna, taking into account the propagation setting
- Use a software-defined radio module to carry out numerical modulations (ASK, FSK, PSK, APSK, QAM).

Necessary prerequisites

Electromagnetism, electronics, linear algebra, telecommunications and related hardware (basic notions).

Practical info

Location(s)

Toulouse

Internet and Security

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Network interconnection part:
o the basic concepts and techniques allowing interconnecting local area networks in the Internet: repeater, bridge, router
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o the main protocols of the TCP/IP Internet architecture : UDP, TCP, IP, ARP/proxy ARP, ICMP, DHCP (Note : RIP, OSPF and BGP are briefly introduced).

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o do architecture choices allowing to take into account requirements and constraints associated to a LAN interconnection,
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o set up (administrate) Ethernet and IP networks in the basic and advanced interconnection contexts considered in the course.

- Distributed algorithm part:
o solve generic problems involved in the implementation of systems distributed
o handle the most general tools allowing to conceptualize them.

- Security part:
o analyse a computer network and its software in order to identify the main vulnerabilities, from software and network point of view and to propose corresponding countermeasures to improve the security of the whole system.

Necessary prerequisites

Course Introduction to computer networks (3MIC)
Cours de programmation distribuée dans les réseaux (socket API) (3MIC)

Practical info

Location(s)

Toulouse

Object Oriented Design and Object Oriented Programming

ECTS
6 crédits

Hourly volume
85h

Introducing

Objectives

At the end of this module, the student will understandd and be able to explain (main concepts):
Object oriented application design based on the UML language, and the
object oriented programming (Java language)

The student will be able to:
* Master object theory and the UML design modelling language
* Master a design methodology based on use cases and integrating detailed analysis and design phases.
* Apply the object concepts and a design methodology using the JAVA language
* Understand the advantages of following best practices guidelines provided by the use of design patterns
* Configure and use the configuration management tools (e.g. Git, Maven, etc.)
* Explore the use of standard documents for project management, requirements specification, software design and software tests.
* Configure and use collaborative workspaces applied to the software development process (e.g., JIRA).
* Have an initial experience to the project management challenges in a software development process project.
* Plan and play designer and developer roles within a software development process.

Necessary prerequisites

Structured programming (ADA, C, Pascal, etc)
Object-oriented programming (basic)

Practical info

Location(s)

Toulouse

French I

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
1 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
5 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Logic and problem solving artificial intelligence

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course is heterogeneous ; it is composed of 3 parts :
- Artificial Intelligence search algorithms for Problem Solving (AI-PS)
- Semantic Web (SW)
- Meta-heuristics (MH)

At the end of this module, students are expected to

[AI-PS]
Develop programs that implement
- A* algorithm for searching the best action plan in a problem-state space
- AO* Algorithm for searching the best problem decomposition graph
- Algorithms for 2-players games : minmax, negamax, alphabeta

[SW part]
Explain the major issues of the semantic web.
Implement the RDF graph model and its use for describing web resources and their metadata.
Design ontologies for knowledge representation, with the OWL language.
Develop an application that access to some ontologies and infers new knowledge through a reasoning.

[MH Part]
Be familiar with he main classes of discrete decision problems and optimization problems.
Implement three main classes of metaheuristics :
- Local search methods
- Evolutionary methods
- Hybrid methods

Necessary prerequisites

Algorithmics and programming
Logic for knowledge representation (1st order predicate calculus)

Tree search algorithms
Exact and approached methods (heuristics) for combinatorial optimization

Practical info

Location(s)

Toulouse

Software and hardware architecture for computer systems

ECTS
6 crédits

Hourly volume
65h

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
- Manipulation of with various type automata, language
theory, parsers, compilers;
- Development of a compiler, management and allocation
of a program memory;
- Introduction to quantic computing
- Specification of hardware components and architectures
in a high-level language;
- Taking Into account the specific material constraints for
embedded systems with limited resources.
-architectures and technologies for green computing, green software for sustainable development
The student will be able to:
- Create parsers and compilers while considering constraints from the environment (embedded or not).
- Understand and design processor architectures
- Select a processor architecture adapted to the software
application and the environment.
- Specify a hardware system in a concurrent language used widely in industry, VHDL and implement this system
on an FPGA.

Necessary prerequisites

C programming, computer architecture

Practical info

Location(s)

Toulouse

Concurrent and real time system

ECTS
4 crédits

Hourly volume
53h

Introducing

Objectives

This module deals with specification, modelling and realisation of parallel, communicating and synchronised systems under time constraints

Necessary prerequisites

MSC: graph theory, Propositional calculus
PTR: language C

Practical info

Location(s)

Toulouse

Research Initiating Project

ECTS
4 crédits

Hourly volume
37h

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involve a team off 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its project defense.

Practical info

Location(s)

Toulouse

[FRANCAIS] Machine Learning

ECTS
2 crédits

Hourly volume

Introducing

Objectives

The objection of this course is to introduce the basic notions of machine learning and in particular the case of supervised learning.

Necessary prerequisites

Linear Algebra, Algorithms and complexity

Practical info

Location(s)

Toulouse

QSE , APS 2

ECTS
4 crédits

Hourly volume
38h

Practical info

Location(s)

Toulouse

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

Objectives

Objectives:
At the end of this module, the student will have understood and be able to explain (main concepts):

-How to answer the demand of the civil society for technical and scientific information
-How to carry out critical analysis in order to give appropriate answers when questioned about such issues
-How to consider the circulation and content of information within the organizations in which they will be hired

The classes given in English will focus on the specific linguistic characteristics of the English used in scientific contexts in order for the students to understand and master them.
The students will also be made aware of the specificities of scientific English as relates to publications in his specific field of research.

Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied ¿ Chinese, German, Spanish ¿ and the level of the student.
They can be consulted on :
https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Necessary knowledge:
For classes in English : understanding of scientific English

Practical info

Location(s)

Toulouse

French II

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Advanced interconnection and long distance networks

ECTS
7 crédits

Hourly volume
103h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain the:
- network architectures and protocols used in operator networks. More precisely, those related to Quality of Service, IPv6, SNMP, inter-domain & intra-domain routing, MPLS and traffic engineering
- wide area data network services that are in use in business, namely VPN (Virtual Private Network) services (Layer 2 and IP) and Carrier Ethernet services
- basics of network optimization, network planning and traffic engineering as well as the accompanying models and algorithms
- main concepts and formalisms used for the description and verification of communication protocols.

The student will be able to:
- Apprehend and master the functioning of Internet core networks (that may conform to the DiffServ framework, with IPv6 and/or MPLS enabled portions, etc.) and manage them
- Design and deploy VPN services for business
- Manage network devices via SNMP
- Apply the appropriate algorithms to network planning and network optimization problems
- Apply formal modelling and verification techniques to communication protocols

Practical info

Location(s)

Toulouse

Architecture of telecommunication systems

ECTS
3 crédits

Hourly volume
41h

Toulouse

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the particularities of different types of networks (optical,
wireless, spatial networks) and their transmission channel.

- The specification, dimensioning, implementing and/or deployment process of equipments of telecommunication systems in order to optimize parameters such as quality of
service, throughput, coverage¿

Necessary prerequisites

I3MITC21 - Signals and telecommunications
I4RTC11 - Transmission Systems and Techniques

Practical info

Location(s)

Concurrent and real time system

ECTS
4 crédits

Hourly volume
53h

Introducing

Objectives

This module deals with specification, modelling and realisation of parallel, communicating and synchronised systems under time constraints

Necessary prerequisites

MSC: graph theory, Propositional calculus
PTR: language C

Practical info

Location(s)

Toulouse

Research Initiating Project

ECTS
4 crédits

Hourly volume
37h

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involve a team off 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its project defense.

Practical info

Location(s)

Toulouse

[FRANCAIS] Machine Learning

ECTS
2 crédits

Hourly volume

Introducing

Objectives

The objection of this course is to introduce the basic notions of machine learning and in particular the case of supervised learning.

Necessary prerequisites

Linear Algebra, Algorithms and complexity

Practical info

Location(s)

Toulouse

French II

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

Objectives

Objectives:
At the end of this module, the student will have understood and be able to explain (main concepts):

-How to answer the demand of the civil society for technical and scientific information
-How to carry out critical analysis in order to give appropriate answers when questioned about such issues
-How to consider the circulation and content of information within the organizations in which they will be hired

The classes given in English will focus on the specific linguistic characteristics of the English used in scientific contexts in order for the students to understand and master them.
The students will also be made aware of the specificities of scientific English as relates to publications in his specific field of research.

Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied ¿ Chinese, German, Spanish ¿ and the level of the student.
They can be consulted on :
https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Necessary knowledge:
For classes in English : understanding of scientific English

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

QSE , APS 2

ECTS
4 crédits

Hourly volume
38h

Practical info

Location(s)

Toulouse

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
1 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
5 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

Objectives

At the end of this module, the student will

¿ Know the legal environment and responsibilities of a business
activity
¿ Be able to objectively assess the financial health of a company and evaluate the rentability of an investment
¿ Realize a market diagnosis (benchmarking) and a business diagnosis in order to make decisions and set goals and strategies
¿ Collect the market data and put in action a business plan adapted to the means and goals of the company
Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied Chinese, German, Spanish ¿ and the level of the student.

They can be consulted on :

https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Mobiles networks and wireless networks

ECTS
6 crédits

Hourly volume
55h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
Mobile networks and wireless networks functioning and deployment principles and their communication and network architecture

The student will be able to:
-understand the cellular architecture of mobile and wireless
networks
-design and deploy a mobile cellular network
-handle the communication and network architecture of mobile networks, the roaming and handover principles
-master the radio access network (RAN) and its impact on
the design of the whole network architecture
-understand the information transmission (voice, data, multimedia) in mobile and wireless network
-understand the energy management and the principles to
adapt the emission power in wireless and mobiles networks
-identify the specificity of wireless local and personal networks and their effects on the network architecture
-handle the main functioning principles of local and personal wireless networks
-design and deploy an enterprise local wireless network

Necessary prerequisites

Telecommunication and Network classes

Practical info

Location(s)

Toulouse

[FRANCAIS] Systèmes de transmission

ECTS
5 crédits

Hourly volume
68h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- How the properties and limitations of channels influence transmission
- The different perturbation sources
- The properties of most antennas
- Modulation and demodulation techniques
- Coding and error-correction techniques.

The student will be able to:
- Identify the limitations of a channel and how they alter the signal
- Build a model of a transmission channel, so as to conceive an adapted and optimized transmission link
- Dimension an antenna, taking into account the propagation setting
- Use a software-defined radio module to carry out numerical modulations (ASK, FSK, PSK, APSK, QAM).

Necessary prerequisites

Electromagnetism, electronics, linear algebra, telecommunications and related hardware (basic notions).

Practical info

Location(s)

Toulouse

Internet and Security

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Network interconnection part:
o the basic concepts and techniques allowing interconnecting local area networks in the Internet: repeater, bridge, router
o the basic concepts and techniques allowing interconnecting LAN in the Internet : subnetting, CIDR, VLAN, VPN, applicative proxy, NAT
o the main protocols of the TCP/IP Internet architecture : UDP, TCP, IP, ARP/proxy ARP, ICMP, DHCP (Note : RIP, OSPF and BGP are briefly introduced).

- Distributed algorithm part:
o principal characteristics of the distributed systems (asynchronism, distribution of control and the data, absence of common knowledge, dynamicity,¿),
o their specific problems and the difficulty of their solution in a distributed context (mutual exclusion, management of the shared data, distributed choice, diffusion, detection of the termination,¿),
o some generic algorithmic tools allowing to solve them: causality, distributed recursivity (waves) and distributed iteration (phases), specific topological structures.

- Security part:
o principles of computer security through the properties that characterize it as well as the classification of the major threats and the corresponding countermeasures,
o main vulnerabilities of computer networks, in particular the Internet network as well as the corresponding countermeasures,
o main software vulnerabilities as well as some countermeasures.

The student will be able to:
- Network Interconnection part:
o do architecture choices allowing to take into account requirements and constraints associated to a LAN interconnection,
o do basic or complex addressing and routing schemas,
o set up (administrate) Ethernet and IP networks in the basic and advanced interconnection contexts considered in the course.

- Distributed algorithm part:
o solve generic problems involved in the implementation of systems distributed
o handle the most general tools allowing to conceptualize them.

- Security part:
o analyse a computer network and its software in order to identify the main vulnerabilities, from software and network point of view and to propose corresponding countermeasures to improve the security of the whole system.

Necessary prerequisites

Course Introduction to computer networks (3MIC)
Cours de programmation distribuée dans les réseaux (socket API) (3MIC)

Practical info

Location(s)

Toulouse

Object Oriented Design and Object Oriented Programming

ECTS
6 crédits

Hourly volume
85h

Introducing

Objectives

At the end of this module, the student will understandd and be able to explain (main concepts):
Object oriented application design based on the UML language, and the
object oriented programming (Java language)

The student will be able to:
* Master object theory and the UML design modelling language
* Master a design methodology based on use cases and integrating detailed analysis and design phases.
* Apply the object concepts and a design methodology using the JAVA language
* Understand the advantages of following best practices guidelines provided by the use of design patterns
* Configure and use the configuration management tools (e.g. Git, Maven, etc.)
* Explore the use of standard documents for project management, requirements specification, software design and software tests.
* Configure and use collaborative workspaces applied to the software development process (e.g., JIRA).
* Have an initial experience to the project management challenges in a software development process project.
* Plan and play designer and developer roles within a software development process.

Necessary prerequisites

Structured programming (ADA, C, Pascal, etc)
Object-oriented programming (basic)

Practical info

Location(s)

Toulouse

French I

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Improve your management abilities

ECTS
4 crédits

Hourly volume
45h

Management I3CCGE51

Introducing

Objectives

At the end of this module, the student will

¿ Know the legal environment and responsibilities of a business
activity
¿ Be able to objectively assess the financial health of a company and evaluate the rentability of an investment
¿ Realize a market diagnosis (benchmarking) and a business diagnosis in order to make decisions and set goals and strategies
¿ Collect the market data and put in action a business plan adapted to the means and goals of the company
Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied Chinese, German, Spanish ¿ and the level of the student.

They can be consulted on :

https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse School of Management

Practical info

Location(s)

Toulouse

Fundamentals in Computer Science

ECTS
7 crédits

Hourly volume
72h

Introducing

Objectives

This course is heterogeneous course and groups 3 parts :
- Functionnal Programming ¿ Caml (¿FP- Caml¿)
- Formal Logic and Logic Programming in Prolog (¿FL- Prolog¿)
- Advanced Algorithmics (« AA »)
At the end of this module, students are expected to :

[FP-Caml]
- understand and write pure functional programs,
- design recursive functions to iterate over recursive data types,
- define variants or parameterized types,
- more generally think in terms of higher-order functions
in order to write reusable codes.
- describe the semantics of simple lambda terms
- have a basic theoretical understanding of the type systems theory

[FL-Prolog part]
- translate natural language statements into formulas of
propositional logic and of 1st order predicate calculus
- apply several methods in order to check the validity and
the consistency of a formula
- explain the fundamentals of logic programming and of
Prolog.
- express problem solving as a demonstration (proof) based on axioms and theorems describing the particular
properties of the problem.
- design a Prolog program and trace its execution

[AA Part]
Some paradigms in algorithmics for discrete optimization :
- Exhaustive enumeration
- Divide and Conquer
- Dynamic Programming
- Greedy Algorithms

Practical info

Location(s)

Toulouse

Hardware Computing µcontrollers

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
o Programming specificities of the peripheral units for microcontroller.
o How to take into account hardware constraints for the design of embedded system.

The student will be able to:
o To select an architecture processor adapted to the software application and to the process configuration.
o To conceive and test the techniques of the programming by hardware interruption.
o To use debug tools and test in the context of crossdevelopment.
o To find information into datasheet.

Necessary prerequisites

I2MAIF11 : Informatique matérielle Electronique numérique
I3MAIF22 : Langage dassemblag

Practical info

Location(s)

Toulouse

Internet and Security

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- Network interconnection part:
o the basic concepts and techniques allowing interconnecting local area networks in the Internet: repeater, bridge, router
o the basic concepts and techniques allowing interconnecting LAN in the Internet : subnetting, CIDR, VLAN, VPN, applicative proxy, NAT
o the main protocols of the TCP/IP Internet architecture : UDP, TCP, IP, ARP/proxy ARP, ICMP, DHCP (Note : RIP, OSPF and BGP are briefly introduced).

- Distributed algorithm part:
o principal characteristics of the distributed systems (asynchronism, distribution of control and the data, absence of common knowledge, dynamicity,¿),
o their specific problems and the difficulty of their solution in a distributed context (mutual exclusion, management of the shared data, distributed choice, diffusion, detection of the termination,¿),
o some generic algorithmic tools allowing to solve them: causality, distributed recursivity (waves) and distributed iteration (phases), specific topological structures.

- Security part:
o principles of computer security through the properties that characterize it as well as the classification of the major threats and the corresponding countermeasures,
o main vulnerabilities of computer networks, in particular the Internet network as well as the corresponding countermeasures,
o main software vulnerabilities as well as some countermeasures.

The student will be able to:
- Network Interconnection part:
o do architecture choices allowing to take into account requirements and constraints associated to a LAN interconnection,
o do basic or complex addressing and routing schemas,
o set up (administrate) Ethernet and IP networks in the basic and advanced interconnection contexts considered in the course.

- Distributed algorithm part:
o solve generic problems involved in the implementation of systems distributed
o handle the most general tools allowing to conceptualize them.

- Security part:
o analyse a computer network and its software in order to identify the main vulnerabilities, from software and network point of view and to propose corresponding countermeasures to improve the security of the whole system.

Necessary prerequisites

Course Introduction to computer networks (3MIC)
Cours de programmation distribuée dans les réseaux (socket API) (3MIC)

Practical info

Location(s)

Toulouse

Object Oriented Design and Object Oriented Programming

ECTS
6 crédits

Hourly volume
85h

Introducing

Objectives

At the end of this module, the student will understandd and be able to explain (main concepts):
Object oriented application design based on the UML language, and the
object oriented programming (Java language)

The student will be able to:
* Master object theory and the UML design modelling language
* Master a design methodology based on use cases and integrating detailed analysis and design phases.
* Apply the object concepts and a design methodology using the JAVA language
* Understand the advantages of following best practices guidelines provided by the use of design patterns
* Configure and use the configuration management tools (e.g. Git, Maven, etc.)
* Explore the use of standard documents for project management, requirements specification, software design and software tests.
* Configure and use collaborative workspaces applied to the software development process (e.g., JIRA).
* Have an initial experience to the project management challenges in a software development process project.
* Plan and play designer and developer roles within a software development process.

Necessary prerequisites

Structured programming (ADA, C, Pascal, etc)
Object-oriented programming (basic)

Practical info

Location(s)

Toulouse

Improving one's autonomy and building one's own professional project level 2 S7

ECTS
4 crédits

Hourly volume
46h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Physical and Sports Activities
The student will be able to:
to list the problems to be solved:
¿ Know the Physical and Sports Activity (rules, meaning, roles, etc.),
¿ Design the objective of the project.
to organize:
¿ Know the constraints, the resources, and the means available,
¿ Know how to choose and plan actions over time,
¿ Know how to get involved in the group and the project: know how to adapt, dare to stimulate action, know how to give up, propose, etc.
to regulate:
¿ Know how to observe,
¿ Know how to carry out a balance sheet,
¿ Know how to readjust the choices if necessary.

Individualized Professional Project
The student should be able to:
¿ Develop your professional vision and define a strategy.
¿ Customize, present and compare your project to professionals
¿ Enrich your professional network
¿ Set development axes, objectives and action plans

Necessary prerequisites

Learning outcomes 1st, 2nd, 3rd year.

Practical info

Location(s)

Toulouse

French I

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Political sciences semester 1

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Advanced interconnection and long distance networks

ECTS
7 crédits

Hourly volume
103h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain the:
- network architectures and protocols used in operator networks. More precisely, those related to Quality of Service, IPv6, SNMP, inter-domain & intra-domain routing, MPLS and traffic engineering
- wide area data network services that are in use in business, namely VPN (Virtual Private Network) services (Layer 2 and IP) and Carrier Ethernet services
- basics of network optimization, network planning and traffic engineering as well as the accompanying models and algorithms
- main concepts and formalisms used for the description and verification of communication protocols.

The student will be able to:
- Apprehend and master the functioning of Internet core networks (that may conform to the DiffServ framework, with IPv6 and/or MPLS enabled portions, etc.) and manage them
- Design and deploy VPN services for business
- Manage network devices via SNMP
- Apply the appropriate algorithms to network planning and network optimization problems
- Apply formal modelling and verification techniques to communication protocols

Practical info

Location(s)

Toulouse

Architecture of telecommunication systems

ECTS
3 crédits

Hourly volume
41h

Toulouse

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the particularities of different types of networks (optical,
wireless, spatial networks) and their transmission channel.

- The specification, dimensioning, implementing and/or deployment process of equipments of telecommunication systems in order to optimize parameters such as quality of
service, throughput, coverage¿

Necessary prerequisites

I3MITC21 - Signals and telecommunications
I4RTC11 - Transmission Systems and Techniques

Practical info

Location(s)

Concurrent and real time system

ECTS
4 crédits

Hourly volume
53h

Introducing

Objectives

This module deals with specification, modelling and realisation of parallel, communicating and synchronised systems under time constraints

Necessary prerequisites

MSC: graph theory, Propositional calculus
PTR: language C

Practical info

Location(s)

Toulouse

Research Initiating Project

ECTS
4 crédits

Hourly volume
37h

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involve a team off 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

At the end of this module, the student wil have a practical experience of the following activities :
- identify a bibliography on a given topic, and present it through a standard formulation (IEEE form).
- write a state-of-the-art synthesis.
- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its project defense.

Practical info

Location(s)

Toulouse

[FRANCAIS] Machine Learning

ECTS
2 crédits

Hourly volume

Introducing

Objectives

The objection of this course is to introduce the basic notions of machine learning and in particular the case of supervised learning.

Necessary prerequisites

Linear Algebra, Algorithms and complexity

Practical info

Location(s)

Toulouse

French II

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

Objectives

Objectives:
At the end of this module, the student will have understood and be able to explain (main concepts):

-How to answer the demand of the civil society for technical and scientific information
-How to carry out critical analysis in order to give appropriate answers when questioned about such issues
-How to consider the circulation and content of information within the organizations in which they will be hired

The classes given in English will focus on the specific linguistic characteristics of the English used in scientific contexts in order for the students to understand and master them.
The students will also be made aware of the specificities of scientific English as relates to publications in his specific field of research.

Module L 2
The objectives, defined in reference to the CEFRL for the 5 language activities, are specific for the language studied ¿ Chinese, German, Spanish ¿ and the level of the student.
They can be consulted on :
https://moodle.insa-toulouse.fr/course/view.php?id=44

In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Necessary knowledge:
For classes in English : understanding of scientific English

Practical info

Location(s)

Toulouse

Communication in organisations

ECTS
6 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

QSE , APS 2

ECTS
4 crédits

Hourly volume
38h

Practical info

Location(s)

Toulouse

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Logic and problem solving artificial intelligence

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course is heterogeneous ; it is composed of 3 parts :
- Artificial Intelligence search algorithms for Problem Solving (AI-PS)
- Semantic Web (SW)
- Meta-heuristics (MH)

At the end of this module, students are expected to

[AI-PS]
Develop programs that implement
- A* algorithm for searching the best action plan in a problem-state space
- AO* Algorithm for searching the best problem decomposition graph
- Algorithms for 2-players games : minmax, negamax, alphabeta

[SW part]
Explain the major issues of the semantic web.
Implement the RDF graph model and its use for describing web resources and their metadata.
Design ontologies for knowledge representation, with the OWL language.
Develop an application that access to some ontologies and infers new knowledge through a reasoning.

[MH Part]
Be familiar with he main classes of discrete decision problems and optimization problems.

Implement three main classes of metaheuristics :
- Local search methods
- Evolutionary methods
- Hybrid methods

Necessary prerequisites

Algorithmics and programming
Logic for knowledge representation (1st order predicate calculus)

Tree search algorithms
Exact and approached methods (heuristics) for combinatorial optimization

Practical info

Location(s)

Toulouse

Software and hardware architecture for computer systems

ECTS
6 crédits

Hourly volume
65h

Introducing

Objectives

At the end of this module, the student will have understood
and be able to explain (main concepts):
- Manipulation of with various type automata, language
theory, parsers, compilers;
- Development of a compiler, management and allocation
of a program memory;
- Introduction to quantic computing
- Specification of hardware components and architectures
in a high-level language;
- Taking Into account the specific material constraints for
embedded systems with limited resources.
-architectures and technologies for green computing, green software for sustainable development
The student will be able to:
- Create parsers and compilers while considering constraints from the environment (embedded or not).
- Understand and design processor architectures
- Select a processor architecture adapted to the software
application and the environment.
- Specify a hardware system in a concurrent language used widely in industry, VHDL and implement this system
on an FPGA.

Necessary prerequisites

C programming, computer architecture

Practical info

Location(s)

Toulouse

Concurrent and real time system

ECTS
4 crédits

Hourly volume
53h

Introducing

Objectives

This module deals with specification, modelling and realisation of parallel, communicating and synchronised systems under time constraints

Necessary prerequisites

MSC: graph theory, Propositional calculus
PTR: language C

Practical info

Location(s)

Toulouse

Research Initiating Project

ECTS
4 crédits

Hourly volume
37h

Introducing

Objectives

The module aims at motivating students with research activities through a selection of tutored projects. Each project involve a team off 6 students tutored by a researcher or an industrial partner. Those projects also benefit from a preliminary training on documentary research techniques to facilit the writing of a state-of-theart review of the domain. A course to project management techniques is also provided to guide students during the realisation phase of the project.

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- precise the perimeter of the realization phase.
- apply project management and collaborative work techniques.
- write a project report and prepare a presentation in english for its project defense.

Practical info

Location(s)

Toulouse

[FRANCAIS] Machine Learning

ECTS
2 crédits

Hourly volume

Introducing

Objectives

The objection of this course is to introduce the basic notions of machine learning and in particular the case of supervised learning.

Necessary prerequisites

Linear Algebra, Algorithms and complexity

Practical info

Location(s)

Toulouse

QSE , APS 2

ECTS
4 crédits

Hourly volume
38h

Practical info

Location(s)

Toulouse

Communication in organisations with LV2

ECTS
6 crédits

Hourly volume

Introducing

Objectives

Objectives:
At the end of this module, the student will have understood and be able to explain (main concepts):

-How to answer the demand of the civil society for technical and scientific information
-How to carry out critical analysis in order to give appropriate answers when questioned about such issues
-How to consider the circulation and content of information within the organizations in which they will be hired

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In certain cases, students may be authorised to follow an English module instead of another language

Necessary prerequisites

Necessary knowledge:
For classes in English : understanding of scientific English

Practical info

Location(s)

Toulouse

French II

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Political sciences semestre 2

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Prescriptive Analytics

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course addresses several efficient models for processing data encountered in industrial combinatorial problems. These models are based on logical inference and mathematical optimisation techniques : constraint satisfaction problems (CSPs), boolean satisfiability (SAT)
and integer linear programming (ILP).
In the first part (CSPs), students are expected to understand and to be able to apply the main constraint propagation techniques and solving strategies, by hand, but are also initiated to programming tools that integrate general solvers (ex : CPLEX) during practical works.
In the SAT modeling part of this course, students are initiated to some propagation and heuristic solving techniques used in SAT solvers (DPPLL, Implication Graphs, Conflict Analysis, Two-watched litterals algorithm). Various applications problems such as allocation, graph colouring, scheduling serve as training examples for SAT encoding.
In the last part (MILPs), students will have to translate industrial problems into mixed-integer linear programs, then to solve them efficiently using branching algorithms or decomposition methods, embedded in existing tools such as CPLEX.

Necessary prerequisites

Algorithmics & programming (I2MIIF11, I2MIIF21). Fundamentals in Computer Science (I4IRIF11), Intelligent Systems (I4IRSD11)

Practical info

Location(s)

Toulouse

Software Defined Communication Infrastructure

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the concepts related to the virtualization of network functions (in the NFV sense)
- the concepts related to network programming (in the SDN sense)
- the model of autonomic computing defined (among others) by IBM
- the views of real-world actors involved in a-large-scale project (application developer,-middleware operator, network operator)

The student will be able to:
- use an SDN network emulator (ContainterNET)
- use an SDN (Ryu) controller
- use a standardized MANO NFV (SON-EMU)
- develop a standardized VNF
- architect and implement solutions that take advantage of the concepts of virtualization of network functions and programmable networks, in the context of the realization of an SDCI
- apply and implement the model of autonomic computing to a problem of management of QoS in an SDCI

Necessary prerequisites

Networks Interconnexion - TCP/IP

Object oriented design UML (2. 0)

Object Oriented Programming - Java

Service-Oriented Architectures

Network Programming - TCP/IP

Practical info

Location(s)

Toulouse

Cloud Computing

ECTS
6 crédits

Hourly volume
69h

Practical info

Location(s)

Toulouse

Model driven engineering

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Modeling, evaluation and optimisation of networks and protocols

ECTS
4 crédits

Hourly volume
78h

Practical info

Location(s)

Toulouse

[FRANCAIS] Commande avancée et supervision

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Projet physique PTP_ISS

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Service Robotics

ECTS
6 crédits

Hourly volume
50h

Toulouse

Introducing

Objectives

At the end of this module, the student would be able to explain the main components of a robot service and to say in which way it differs from industrial robotics; he/she will know the main concepts in humanoid robotics and why it is difficult to control a walking robot. His/her knowledge will
include the main notions in jointed robotics: direct and inverse kinematic models, dynamic model of the robot, trajectory generation and stability of a bipedal robot.

The student is supposed to be able to model a jointed robot, to understand its technical components and to analyse the functioning of a service robot in its domestic or professional environment.

Necessary prerequisites

Matrix theory, Linear control

Practical info

Location(s)

Software engineering and service oriented architectures

ECTS
4 crédits

Hourly volume
41h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- Software project lifecycle
- The challenges of software development
- Project management methods, particularly the agile method
- Service oriented architecture
- Resource oriented architecture (RESTful)
- Microservice architecture

The student will be able to:
- Control the conduct of a software development project with a team by following the scrum agile method
- Perform requirement analysis: expression, analysis and transformation into technical requirements
- Design and develop a service oriented architecture
- Implement Web services SOAP and Rest
- Develop a service composition (orchestration) via BPEL
- Develop microservices
- Understand and implement a RESTfull API

Necessary prerequisites

Algorithmic, Object oriented programming (Java), Object oriented design (UML), XML, and XML schema

Practical info

Location(s)

Toulouse

Reliability and model-checking

ECTS
4 crédits

Hourly volume
42h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain the main principles of systems engineering and software engineering: concepts, methods and tools, to define and control the process development of a critical embedded system.

The student will be able to:

- apply these general competences to computer based systems
.explain different methods and chose the best adapted to develop a specific application.

Necessary prerequisites

Petri Nets, Communicating Automata, formal Logic, Graph theory

Practical info

Location(s)

Toulouse

[FRANCAIS] Analyse descriptive et prédictive

ECTS
4 crédits

Hourly volume
56h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- the different problems associated with data study (in exploratory data analysis and in machine learning)
- the main concepts and algorithms allowing to solve those problems
- the main existing libraries

The student will be able to:
- analyze the requirements of the data processing
- set up the most efficient algorithms
- use the algorithms that are implemented in the main existing libraries
- adapt and develop his/her own algorithms
- analyze and explain the results of those algorithms
- program in Python and R languages

Necessary prerequisites

Algorithms, data structures, computational complexity, programming, optimization, supervised machine learning (basic knowledge), statistics and probability (basic knowledge), programming

Practical info

Location(s)

Toulouse

Infrastructure for massive data processing

ECTS
4 crédits

Hourly volume
61h

Introducing

Objectives

At the end of this module, the student will understand and be able to explain the concepts and techniques related to the main pillars that have to be managed by an IT service provider, in terms of:

- physical infrastructure (network, storage , computing) ;
- organizational and data management (allocation of storage , ...);
- computation services of such data (based on calculation models like map reduce, etc.).

The student will be able to:

1) With regard to physical infrastructures
- design and deploy a network architecture adapted to a big data oriented service, using advanced network technology (network virtualization, optimization protocols, etc.);
- dimension and deploy a physical storage infrastructure aimed at receiving massive amounts of data;
- assess and deploy the computing power required to process massive data, based on the latest technologies for processors, such as virtualization.

2) With regard to the organization and data management
- design and implement tools to organize data within the physical infrastructure;
- provide appropriate interfaces for access to such data;
- choose a data organization adapted to the constraints of treatment (offline versus real-time processing);

3) With regard to the data processing services
- provide facilities for analyzing data and extract value added information (e.g., learning, trends).

Necessary prerequisites

Networks
Operating systems
Databases
Algorithmic and programing

Practical info

Location(s)

Toulouse

[FRANCAIS] Projet SDBD

ECTS
4 crédits

Hourly volume
52h

Toulouse

Introducing

Objectives

At the end of this module, the student should have understood and will be able to explain:

- The objectives of an Artificial Intelligence and Big Data project
- The methodological and technological choices retained and developed to respond to a specific project

The student should be able:
- To create a software chain for the collection, storage and processing of massive data,
- to argue about the choices made,
- to evaluate the proposed solution.

Necessary prerequisites

Descriptive and Predictive Analysis, Big Data Infrastructures

Practical info

Location(s)

Human relations

ECTS
6 crédits

Hourly volume
78h

Introducing

Location(s)

Toulouse

Objectives

L'étudiant devra être capable de :
-Analyser des situations de groupe avec des concepts issus de la psychologie sociale
-Identifier les dimensions éthiques de ces situations et prendre position
-Repérer et comprendre des informations liées aux RH
-Analyser une situation de management d¿équipe en référence à un cadre théorique
-Formuler et argumenter des solutions managériales
-Agir dans un milieu naturel : analyser, décider, agir ; mettre en œuvre la sécurité, utiliser du matériel spécifique. découvrir un site.
-Respecter et s'intégrer dans un environnement différent de ses habitudes
-S'engager avec cohérence dans le projet d'activités
-Prendre part activement au collectif
-Valider son projet professionnel et construire une stratégie pour trouver un emploi

Necessary prerequisites

None

Practical info

Module élève ingénieur (UE PETAR dispensée UPS)

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Prescriptive Analytics

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course addresses several efficient models for processing data encountered in industrial combinatorial problems. These models are based on logical inference and mathematical optimisation techniques : constraint satisfaction problems (CSPs), boolean satisfiability (SAT)
and integer linear programming (ILP).
In the first part (CSPs), students are expected to understand and to be able to apply the main constraint propagation techniques and solving strategies, by hand, but are also initiated to programming tools that integrate general solvers (ex : CPLEX) during practical works.
In the SAT modeling part of this course, students are initiated to some propagation and heuristic solving techniques used in SAT solvers (DPPLL, Implication Graphs, Conflict Analysis, Two-watched litterals algorithm). Various applications problems such as allocation, graph colouring, scheduling serve as training examples for SAT encoding.
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Necessary prerequisites

Algorithmics & programming (I2MIIF11, I2MIIF21). Fundamentals in Computer Science (I4IRIF11), Intelligent Systems (I4IRSD11)

Practical info

Location(s)

Toulouse

Software Defined Communication Infrastructure

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the concepts related to the virtualization of network functions (in the NFV sense)
- the concepts related to network programming (in the SDN sense)
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- the views of real-world actors involved in a-large-scale project (application developer,-middleware operator, network operator)

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Necessary prerequisites

Networks Interconnexion - TCP/IP

Object oriented design UML (2. 0)

Object Oriented Programming - Java

Service-Oriented Architectures

Network Programming - TCP/IP

Practical info

Location(s)

Toulouse

Cloud Computing

ECTS
6 crédits

Hourly volume
69h

Practical info

Location(s)

Toulouse

Model driven engineering

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Modeling, evaluation and optimisation of networks and protocols

ECTS
4 crédits

Hourly volume
78h

Practical info

Location(s)

Toulouse

[FRANCAIS] Commande avancée et supervision

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Projet physique PTP_ISS

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Service Robotics

ECTS
6 crédits

Hourly volume
50h

Toulouse

Introducing

Objectives

At the end of this module, the student would be able to explain the main components of a robot service and to say in which way it differs from industrial robotics; he/she will know the main concepts in humanoid robotics and why it is difficult to control a walking robot. His/her knowledge will
include the main notions in jointed robotics: direct and inverse kinematic models, dynamic model of the robot, trajectory generation and stability of a bipedal robot.

The student is supposed to be able to model a jointed robot, to understand its technical components and to analyse the functioning of a service robot in its domestic or professional environment.

Necessary prerequisites

Matrix theory, Linear control

Practical info

Location(s)

Human relations

ECTS
6 crédits

Hourly volume
78h

Introducing

Location(s)

Toulouse

Objectives

L'étudiant devra être capable de :
-Analyser des situations de groupe avec des concepts issus de la psychologie sociale
-Identifier les dimensions éthiques de ces situations et prendre position
-Repérer et comprendre des informations liées aux RH
-Analyser une situation de management d¿équipe en référence à un cadre théorique
-Formuler et argumenter des solutions managériales
-Agir dans un milieu naturel : analyser, décider, agir ; mettre en œuvre la sécurité, utiliser du matériel spécifique. découvrir un site.
-Respecter et s'intégrer dans un environnement différent de ses habitudes
-S'engager avec cohérence dans le projet d'activités
-Prendre part activement au collectif
-Valider son projet professionnel et construire une stratégie pour trouver un emploi

Necessary prerequisites

None

Practical info

Embedded Computer Architecture

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student should have understood and be able to explain:

- The principles and specificities of networks used in embedded systems in the automotive, avionics and connected objects,
- The specificities of operating systems and their main services (scheduling, memory, privileges,
etc.) for embedded systems
- The advantages and disadvantages of the different computer architectures used for embedded
systems
- The elements impacting the performance (computation, energy consumption, etc.) of a computer architecture and the methods to optimize them.

The student will be able to:
- Choose a network technology that meets the needs of an embedded system,
- Set up the support network of an embedded system,
- Deploy an operating system on an embedded architecture,
- Develop a driver within an operating system,
- Compare two embedded computer architectures in terms of performance,
- Choose a computer architecture adapted to the needs of an application.

Necessary prerequisites

C programming, computer organization, network, operating system

Practical info

Location(s)

Toulouse

Engineering methods

ECTS
4 crédits

Hourly volume
42h

Introducing

Objectives

Present the main principles of systems engineering and software engineering: concepts, methods and tools, to define and control the process development of a critical embedded system.

The student will be able to:
- apply these general competences to computer based embedded systems explain different methods and chose the best adapted
to develop a specific application.

Practical info

Location(s)

Toulouse

Dependability

ECTS
5 crédits

Hourly volume
68h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

The basic concepts of dependability and main methods and techniques for obtaining and validation of the safety.

The student will be able to:
- apply these general competences to computer based embedded systems
- explain different methods and chose the best adapted to develop a specific application.

Necessary prerequisites

Discrete event systems, Propositional Logic,

Practical info

Location(s)

Toulouse

Interdisciplinary Project

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will be able to:
- Implement and apply agile management according to the agile method in order to create a product,
- Select and interweave a set of interdisciplinary technical skills in order to develop a critical embedded system,
- Search autonomously and be able to critique technical solutions for which he/she does not have prior knowledge in order to meet requirements specific to critical embedded systems,
- Design and build a product deployed on a heterogeneous and communicating embedded architecture guaranteeing performance properties,
- Define needs, requirements and architecture when designing a product
- Communicate in an interdisciplinary context and to work together with actors with heterogeneous skills,
- Adapt the writing and presentation of scientific results according to the audience (client, decision maker, evaluator, general public) and through various media (presentation, website, report, synthesis, poster).

To express themselves correctly in English, using a concise and precise style respecting the conventions of genre in writing as well as orally

Practical info

Location(s)

Toulouse

Security fundamentals

ECTS
5 crédits

Hourly volume
77h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain:

- main concepts of operating systems, TCP/IP networks and language C and assembling programming;
- main concepts of dependability
- main concepts of cryptography

The student will be able to:

- describe the main components of an information system
- describe the main principles of the network protocols, analyse network traces and understand the flow encapsulation
- design and implement basic and advanced language C programs as well as basic assembling programs
- understand the different issues of the safety and security domains and correctly use the associated terminology
- distinguish the different cryptographic tools, understand when and how choose a specific tool, its capabilities and weaknesses
- find the main international cryptographic standards, and understand their content
- deploying high level security tools such as PKI, VPN, IPSEC tools or low-level security tools such as openssl, and choosing purposely the parametrisation of such tools

Practical info

Location(s)

Toulouse

Software security

ECTS
4 crédits

Hourly volume
47h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The different types of software vulnerabilities that are frequently encountered, especially in programs written in C language;
- The main memories protections to protect software from these types of vulnerabilities;
- The theory related to worms and viruses, especially the algorithms used by these malware to infect computer systems and spread on the internet; the protection against these malicious software and the methods employed by antivirus to detect worms and viruses;
- Best practices for developing software securely.
- Formal methods for security

The student will be able to:

- Develop software taking into account the risks associated with software vulnerabilities;
- Use formal methods to detect software vulnerabilities;
- Appreciate the challenges of viral protection, describe the different types of computer infection, viral and analyze the technical and antiviral éagir in case of infection.

Necessary prerequisites

Good programming skills in C and assembly language;
- A minimum of knowledge about the internals of the OS;
- Bases in algebra and the use of automata theory.

Practical info

Location(s)

Toulouse

System security, hardware security and reverse

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The main protection mechanisms that now exist in the kernel of operating system;
- The main attacks carried out from hardware component and associated contermeasures;
- The internals of the key hardware components for security such as hypervisor and IOMMU;
- The advantages of latest advances in hardware protection carried out by the founders of processors and chipset;
- The logic of physical attacks targeting computer systems;
- Reverse engineering software (reverse engineering) while being able to explain the toolchain of the compilation with the models used by compilers to generate machine code;
- Strategies to make reverse engineering software more difficult to achieve.

The student will be able to:

- Identify the most suitable software components to protect the operating system software against attacks;
- Identify threats from lower layers to higher layers and attack vectors to be considered in a system;
- Obtain an overview of the exchanges between the hardware components of a system to identify critical components and determine the contermeasures to integrate into the operating system;
- Identify threats on the physical components of a system;
- Conduct a reverse engineering of malware to understand their behavior and generate signatures to detect them.

Necessary prerequisites

Good programming skills in C and assembly language;

- A minimum of knowledge about the internals of the OS;
- Bases in algebra and the use of automata theory.

Practical info

Location(s)

Toulouse

Networks and protocols security

ECTS
3 crédits

Hourly volume
40h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the main concepts of network security, main threats targeting these networks and associated protection mechanisms
- the main concepts of non wired network security (Wifi, GSM, GPRS, LTE, UMTS)
- the main weaknesses of the network protocols and how to eliminate these weaknesses

The student will be able to:

- Understand and carry out basic networks attacks in the context of intrusion tests ; identify and imlement protection mechanisms mitigating these attacks, use and install protection infrastructures
- Choose a security solution dedicated to a Wifi access point; carry out intrusion tests on an access point
- Distinguish the security objectives in different cellular networks ; describe authentication mechanisms and key exchange protocols ; describe the different attacks targeting these different technologies ; identify the architectural components of security in operator networks
- Identify the weak protocols currently used in networks ; propose solutions for these weaknesses, through the use of tunnels when this is necessary ; use SSH and its associated functionnalities (file transfers ,proxies, etc) ; describe the good practices for the definition of a secure network protocol

Necessary prerequisites

Knowledges and skills in computer networks and the underlying protocols are required (TCP/IP, routing protocols). The corresponding terminology must be known and the main concepts of cryptography must be clearly understood.

Practical info

Location(s)

Toulouse

Architectures of secured networks

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The main concepts associated to the design and the implementation of secure network architectures
- The main tools and technics allowing to implement protection measures, and their usage according to the different contexts and objectives
- The vulnerabilities inherent in system architectures and network and major intrusion techniques;
- The operation of the main vulnerabilities of the web.

The student will be able to:

- Identify the different classes of firewalls as well as their functionalities and weaknesses
- Define and audit a filtering architecture dedicated to a specific network
- Choose, for an IPSEC tunnel, the correct protocols, the correct execution modes and a routing plan adapted to the associated gatewaus
- Implement and audit such an IPSEC tunnel
- Deploy and audit a VPN based on IPSEC, either by configuring ¿by hand¿ the VPN or by using all-in-one preconfigured tools available
- Deploy and audit a network intrusion detection system (or intrusion prevention system)
- Design a complete security architecture for a complex network
- Identify the advantages and limitations of different intrusion detection solutions;
- Position the intrusion detection sensors efficiently;
- Analyze the events collected by the sensors and correlate these events to identify a real threat.
- Identify vulnerabilities in web architectures and propose solutions to achieve effective protection.

Necessary prerequisites

Good knowledge of web architectures, cryptography and networks.

Practical info

Location(s)

Toulouse

[FRANCAIS] Sécurité des systèmes embarqués critiques

ECTS
5 crédits

Hourly volume
31h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The different techniques used today to secure ground / air communications with satellites;
- Issues related to different types of mission and standards used;
- The means for securing transmissions spread spectrum (TRANSSEC);
- The principles of the computer network for air traffic management (ATM) and related security issues;
- The principles and issues of security management in the context of the DGAC.

The student will be able to:
- Make relevant choice for securing ground / air communications architectures;
- Perform a black box analysis of a critical embedded system

Practical info

Location(s)

Toulouse

[FRANCAIS] SHSJ

ECTS
5 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

[FRANCAIS] UE commune M2 RT

ECTS
9 crédits

Hourly volume
45h

Practical info

Location(s)

Toulouse

Smart Devices

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

SMART SENSORS AND ACQUISITION CHAIN:
- The criteria for the design and use of a "smart device" and an acquisition chain
It will be capable of handling:
- The physical principles of sensors operation
- The concepts used in metrology
- Procedures implemented,
- electrical "conditioners"
- The design of an acquisition chain and a "smart device".
MICROCONTROLERS AND OPEN SOURCE HARDWARE: the elements necessary for the design and implementation of concrete applications in Open Source Hardware,

DESIGN OF A CIRCUIT IN ANALOG ELECTRONICS:
It will be able to design and simulate an amplification stage dedicated to the measurement of the sensor realized

DESIGN OF AN ELECTRONIC BOARD OF THE SENSOR:
He will be able to design and build an electronic board containing the sensor, its conditioning electronics and the communication elements necessary to send the data on a low speed network such as LoRa.

NANO-SENSOR:
- The approach of making nano devices and micro-electronic methods by integrating low-cost nano-objects prepared in solution;
- The operation of a nano-sensor.

The student will have understood and be able to explain:
- Experimental concepts and practices to synthesis nano-objects in liquid phase; Stabilization of colloidal solutions;
- Experimental concepts and practices of deposits of these nano-objects as 2D and 3D networks;
- The physical principles of sensors based on nanoparticles (gas sensors, stress ...)
The student will be able to:
- Experimentally produce a nanoparticle-based sensor that will be synthesized and assembled between two electrodes;
- Measure the properties of the sensor and describe its operation;
- Discuss experimental results and suggest improvements

Necessary prerequisites

General physic and electronic lectures. C et C++ programming

Practical info

Location(s)

Toulouse

Communication

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

-the communication architectures and protocols for wireless sensors networks and Internet of Things (IoT)
-the quality of services for adaptative networks (routing layer, MAC layer, beamforming algorithms)
- the functioning of adaptative networks and adaptative communication services
-the Software Defined Radio (SDR) and cognitive radio principles (reconfigurability in mobile networks)
-the functioning and the services of 4G and 5G networks
-the overall architecture of an energy management system, capturing or not ambient energy.
-the difficulties to assure the integrity, the availability and the confidentiality of the deployed equipment on a large scale, in different environments using heterogeneous communication interfaces

The student will be able to:

-design, dimensioning and deploying a wireless sensor networks depending on the applications
- having strong knowledges about quality of service on the MAC layer and beamforming algorithms
-having strong knowledges on 4G and 5G networks and adaptative networks
-identify the information to protect in IoT with respect to the security properties
-analyse the communication interferences to characterise the weakness of the system
-propose or modify the communication architectures to take into account the security problems
-design the energy management of a connected object

Practical info

Location(s)

Toulouse

Middleware and services

ECTS
5 crédits

Hourly volume
62h

Introducing

Objectives

This training consists of 3 parts, the following concepts will be discussed:
- Service oriented architectures
- Middlewares
- The Middleware for the Internet of Things through standards and the deployment of an architecture of sensors networks.
- The concept of Cloud and especially Infrastructure As A Service.
- Dynamic management through the principles of autonomic computing

The student will be able to:
- Design and develop a service oriented architecture
- Implement Web services SOAP and Rest
- Develop a service composition (orchestration) via BPEL
- Know the main standards of the Internet of Things
- Deploy an architecture according to a standard and implement a sensor network system services
- Understand the concept of cloud
- Use a cloud infrastructure in Infrastructure as a Service
- Recognise the different architecture types (type 1 and type 2) of cloud hypervisors
- Provision service-based (develop, deploy, manage) in cloud environment using Docker containers
- Deploy and adapt an Internet of things platform on cloud and manage it with autonomic concept

Necessary prerequisites

Java programming, Object Oriented design, base notion on network, XML and XML schema, NodeJS

Practical info

Location(s)

Toulouse

Analysis and data processing, business applications

ECTS
4 crédits

Hourly volume
37h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

Data management:
Exploratory/confirmatory data analysis. Algorithmic Complexity vs. development costs, parallelism, software engineering notions (life cycle of a data analysis pipeline).
Data visualisation techniques.

Semantic manipulation:
- What an ontology is
- What are the main constituting elements of an ontology
- What are the perks of enriched data compared to raw data

Software engineering:
- Software project lifecycle
- The challenges of software development
- Project management methods, including agile method

The student will be able to:
- Explore a dataset, leverage it to answer specific questions, and present the results of this analysis -incl. Its limits- in a synthetic written report.
- Design an ontology to capture domain knowledge
- Discover and reuse knowledge sources (ontologies, knowledge bases) online
- Enrich a dataset with semantic metadata
- Control the conduct of a software development project with a team by following the agile method
- Perform requirement analysis: expression, analysis and transformation into technical requirements

Necessary prerequisites

- Algorithms and programming
- Statistics (notions)
- Java programming
- Web technologies background knowledge

Practical info

Location(s)

Toulouse

Innovative project

ECTS
5 crédits

Hourly volume
76h

Introducing

Objectives

The student will be able to:
(English course)
- present their scientific research in a clear, logical, and organized manner, both orally and in a written report
- adapt their register to their audience and follow standard scientific publication standards with respect to format and appropriate style
- quote scientific sources according to international citation standards
- use specific technical vocabulary and terms relevant to their field of study

Regarding the innovative project, students will be able to carry out an innovative project using the skills learnt during this semester. The project will cover the specification, design, implementation and a presentation to a jury of academia and industry.

Necessary prerequisites

(English) Students must master general English and follow strict standard scientific guidelines for both oral presentations and written abstracts and reports.

Practical info

Location(s)

Toulouse

Innovation and humanity

ECTS
6 crédits

Hourly volume
76h

Introducing

Objectives

Aims
The student will learn how to:
¿ Analyze group situations using social psychology concepts
¿ Identify the ethical dimensions of these situations and take a stance
¿ Identify and understand HR-related information
¿ Analyze a team management situation in a theoretical context
¿ Formulate and justify managerial decisions
¿ Operate in a natural environment: analysis, decision, action, safety implementation, use of specific equipment, site exploration
¿ Respect and adapt to an environment that is different from their own
¿ Consistently commit to the activity project
¿ Take an active role within the group
¿ Fulfill their career objectives, build a strategic plan and acquire job searching skills.

Necessary prerequisites

Prerequisites
None

Practical info

Location(s)

Toulouse

Qualitative Approach

ECTS
4 crédits

Hourly volume
45h

Practical info

Location(s)

Toulouse

Quantitative Approach

ECTS
5 crédits

Hourly volume
45h

Practical info

Location(s)

Toulouse

Designing for safety

ECTS
5 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Process Safety

ECTS
5 crédits

Hourly volume
45h

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Functional Safety

Practical info

Location(s)

Toulouse

[FRANCAIS] Structural Safety

Practical info

Location(s)

Toulouse

Human relations

ECTS
6 crédits

Hourly volume
78h

Introducing

Location(s)

Toulouse

Objectives

L'étudiant devra être capable de :
-Analyser des situations de groupe avec des concepts issus de la psychologie sociale
-Identifier les dimensions éthiques de ces situations et prendre position
-Repérer et comprendre des informations liées aux RH
-Analyser une situation de management d¿équipe en référence à un cadre théorique
-Formuler et argumenter des solutions managériales
-Agir dans un milieu naturel : analyser, décider, agir ; mettre en œuvre la sécurité, utiliser du matériel spécifique. découvrir un site.
-Respecter et s'intégrer dans un environnement différent de ses habitudes
-S'engager avec cohérence dans le projet d'activités
-Prendre part activement au collectif
-Valider son projet professionnel et construire une stratégie pour trouver un emploi

Necessary prerequisites

None

Practical info

Toxic risks

ECTS
5 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

Energy production from renewable resources

ECTS
5 crédits

Hourly volume
32h

Practical info

Location(s)

Toulouse

Technologies and architectures for the conversion and storage of electrical energy

ECTS
5 crédits

Hourly volume
47h

Practical info

Location(s)

Toulouse

Innovative materials for the energy

ECTS
5 crédits

Hourly volume
15h

Practical info

Location(s)

Toulouse

Combination of multi-sources of energy platform

ECTS
9 crédits

Hourly volume
161h

Practical info

Location(s)

Toulouse

The different generation technologies and energy management

ECTS
5 crédits

Hourly volume
7h

Practical info

Location(s)

Toulouse

Human relations

ECTS
6 crédits

Hourly volume
78h

Introducing

Location(s)

Toulouse

Objectives

L'étudiant devra être capable de :
-Analyser des situations de groupe avec des concepts issus de la psychologie sociale
-Identifier les dimensions éthiques de ces situations et prendre position
-Repérer et comprendre des informations liées aux RH
-Analyser une situation de management d¿équipe en référence à un cadre théorique
-Formuler et argumenter des solutions managériales
-Agir dans un milieu naturel : analyser, décider, agir ; mettre en œuvre la sécurité, utiliser du matériel spécifique. découvrir un site.
-Respecter et s'intégrer dans un environnement différent de ses habitudes
-S'engager avec cohérence dans le projet d'activités
-Prendre part activement au collectif
-Valider son projet professionnel et construire une stratégie pour trouver un emploi

Necessary prerequisites

None

Practical info

[FRANCAIS] Challenge – Formation ECIU

ECTS
1 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
2 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
3 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Challenge – Formation ECIU

ECTS
5 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Training period 4th year

ECTS
9 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Projet Long N7

ECTS
8 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Training period 5th year

ECTS
21 crédits

Hourly volume

Practical info

Location(s)

Toulouse

[FRANCAIS] Stage PFE N7

ECTS
22 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Prescriptive Analytics

ECTS
4 crédits

Hourly volume

Introducing

Objectives

This course addresses several efficient models for processing data encountered in industrial combinatorial problems. These models are based on logical inference and mathematical optimisation techniques : constraint satisfaction problems (CSPs), boolean satisfiability (SAT)
and integer linear programming (ILP).
In the first part (CSPs), students are expected to understand and to be able to apply the main constraint propagation techniques and solving strategies, by hand, but are also initiated to programming tools that integrate general solvers (ex : CPLEX) during practical works.
In the SAT modeling part of this course, students are initiated to some propagation and heuristic solving techniques used in SAT solvers (DPPLL, Implication Graphs, Conflict Analysis, Two-watched litterals algorithm). Various applications problems such as allocation, graph colouring, scheduling serve as training examples for SAT encoding.
In the last part (MILPs), students will have to translate industrial problems into mixed-integer linear programs, then to solve them efficiently using branching algorithms or decomposition methods, embedded in existing tools such as CPLEX.

Necessary prerequisites

Algorithmics & programming (I2MIIF11, I2MIIF21). Fundamentals in Computer Science (I4IRIF11), Intelligent Systems (I4IRSD11)

Practical info

Location(s)

Toulouse

Software Defined Communication Infrastructure

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the concepts related to the virtualization of network functions (in the NFV sense)
- the concepts related to network programming (in the SDN sense)
- the model of autonomic computing defined (among others) by IBM
- the views of real-world actors involved in a-large-scale project (application developer,-middleware operator, network operator)

The student will be able to:
- use an SDN network emulator (ContainterNET)
- use an SDN (Ryu) controller
- use a standardized MANO NFV (SON-EMU)
- develop a standardized VNF
- architect and implement solutions that take advantage of the concepts of virtualization of network functions and programmable networks, in the context of the realization of an SDCI
- apply and implement the model of autonomic computing to a problem of management of QoS in an SDCI

Necessary prerequisites

Networks Interconnexion - TCP/IP

Object oriented design UML (2. 0)

Object Oriented Programming - Java

Service-Oriented Architectures

Network Programming - TCP/IP

Practical info

Location(s)

Toulouse

Cloud Computing

ECTS
6 crédits

Hourly volume
69h

Practical info

Location(s)

Toulouse

Model driven engineering

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Modeling, evaluation and optimisation of networks and protocols

ECTS
4 crédits

Hourly volume
78h

Practical info

Location(s)

Toulouse

[FRANCAIS] Commande avancée et supervision

ECTS
6 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Projet physique PTP_ISS

ECTS
4 crédits

Hourly volume

Practical info

Location(s)

Toulouse

Service Robotics

ECTS
6 crédits

Hourly volume
50h

Toulouse

Introducing

Objectives

At the end of this module, the student would be able to explain the main components of a robot service and to say in which way it differs from industrial robotics; he/she will know the main concepts in humanoid robotics and why it is difficult to control a walking robot. His/her knowledge will
include the main notions in jointed robotics: direct and inverse kinematic models, dynamic model of the robot, trajectory generation and stability of a bipedal robot.

The student is supposed to be able to model a jointed robot, to understand its technical components and to analyse the functioning of a service robot in its domestic or professional environment.

Necessary prerequisites

Matrix theory, Linear control

Practical info

Location(s)

Engineering methods

ECTS
4 crédits

Hourly volume
42h

Introducing

Objectives

Present the main principles of systems engineering and software engineering: concepts, methods and tools, to define and control the process development of a critical embedded system.

The student will be able to:
- apply these general competences to computer based embedded systems explain different methods and chose the best adapted
to develop a specific application.

Practical info

Location(s)

Toulouse

Embedded Computer Architecture

ECTS
4 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student should have understood and be able to explain:

- The principles and specificities of networks used in embedded systems in the automotive, avionics and connected objects,
- The specificities of operating systems and their main services (scheduling, memory, privileges,
etc.) for embedded systems
- The advantages and disadvantages of the different computer architectures used for embedded
systems
- The elements impacting the performance (computation, energy consumption, etc.) of a computer architecture and the methods to optimize them.

The student will be able to:
- Choose a network technology that meets the needs of an embedded system,
- Set up the support network of an embedded system,
- Deploy an operating system on an embedded architecture,
- Develop a driver within an operating system,
- Compare two embedded computer architectures in terms of performance,
- Choose a computer architecture adapted to the needs of an application.

Necessary prerequisites

C programming, computer organization, network, operating system

Practical info

Location(s)

Toulouse

Human relations

ECTS
6 crédits

Hourly volume
78h

Introducing

Location(s)

Toulouse

Objectives

L'étudiant devra être capable de :
-Analyser des situations de groupe avec des concepts issus de la psychologie sociale
-Identifier les dimensions éthiques de ces situations et prendre position
-Repérer et comprendre des informations liées aux RH
-Analyser une situation de management d¿équipe en référence à un cadre théorique
-Formuler et argumenter des solutions managériales
-Agir dans un milieu naturel : analyser, décider, agir ; mettre en œuvre la sécurité, utiliser du matériel spécifique. découvrir un site.
-Respecter et s'intégrer dans un environnement différent de ses habitudes
-S'engager avec cohérence dans le projet d'activités
-Prendre part activement au collectif
-Valider son projet professionnel et construire une stratégie pour trouver un emploi

Necessary prerequisites

None

Practical info

Interdisciplinary Project

ECTS
5 crédits

Hourly volume

Introducing

Objectives

At the end of this module, the student will be able to:
- Implement and apply agile management according to the agile method in order to create a product,
- Select and interweave a set of interdisciplinary technical skills in order to develop a critical embedded system,
- Search autonomously and be able to critique technical solutions for which he/she does not have prior knowledge in order to meet requirements specific to critical embedded systems,
- Design and build a product deployed on a heterogeneous and communicating embedded architecture guaranteeing performance properties,
- Define needs, requirements and architecture when designing a product
- Communicate in an interdisciplinary context and to work together with actors with heterogeneous skills,
- Adapt the writing and presentation of scientific results according to the audience (client, decision maker, evaluator, general public) and through various media (presentation, website, report, synthesis, poster).

To express themselves correctly in English, using a concise and precise style respecting the conventions of genre in writing as well as orally

Practical info

Location(s)

Toulouse

Dependability

ECTS
5 crédits

Hourly volume
68h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

The basic concepts of dependability and main methods and techniques for obtaining and validation of the safety.

The student will be able to:
- apply these general competences to computer based embedded systems
- explain different methods and chose the best adapted to develop a specific application.

Necessary prerequisites

Discrete event systems, Propositional Logic,

Practical info

Location(s)

Toulouse

Security fundamentals

ECTS
5 crédits

Hourly volume
77h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain:

- main concepts of operating systems, TCP/IP networks and language C and assembling programming;
- main concepts of dependability
- main concepts of cryptography

The student will be able to:

- describe the main components of an information system
- describe the main principles of the network protocols, analyse network traces and understand the flow encapsulation
- design and implement basic and advanced language C programs as well as basic assembling programs
- understand the different issues of the safety and security domains and correctly use the associated terminology
- distinguish the different cryptographic tools, understand when and how choose a specific tool, its capabilities and weaknesses
- find the main international cryptographic standards, and understand their content
- deploying high level security tools such as PKI, VPN, IPSEC tools or low-level security tools such as openssl, and choosing purposely the parametrisation of such tools

Practical info

Location(s)

Toulouse

Software security

ECTS
4 crédits

Hourly volume
47h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The different types of software vulnerabilities that are frequently encountered, especially in programs written in C language;
- The main memories protections to protect software from these types of vulnerabilities;
- The theory related to worms and viruses, especially the algorithms used by these malware to infect computer systems and spread on the internet; the protection against these malicious software and the methods employed by antivirus to detect worms and viruses;
- Best practices for developing software securely.
- Formal methods for security

The student will be able to:

- Develop software taking into account the risks associated with software vulnerabilities;
- Use formal methods to detect software vulnerabilities;
- Appreciate the challenges of viral protection, describe the different types of computer infection, viral and analyze the technical and antiviral éagir in case of infection.

Necessary prerequisites

Good programming skills in C and assembly language;
- A minimum of knowledge about the internals of the OS;
- Bases in algebra and the use of automata theory.

Practical info

Location(s)

Toulouse

System security, hardware security and reverse

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The main protection mechanisms that now exist in the kernel of operating system;
- The main attacks carried out from hardware component and associated contermeasures;
- The internals of the key hardware components for security such as hypervisor and IOMMU;
- The advantages of latest advances in hardware protection carried out by the founders of processors and chipset;
- The logic of physical attacks targeting computer systems;
- Reverse engineering software (reverse engineering) while being able to explain the toolchain of the compilation with the models used by compilers to generate machine code;
- Strategies to make reverse engineering software more difficult to achieve.

The student will be able to:

- Identify the most suitable software components to protect the operating system software against attacks;
- Identify threats from lower layers to higher layers and attack vectors to be considered in a system;
- Obtain an overview of the exchanges between the hardware components of a system to identify critical components and determine the contermeasures to integrate into the operating system;
- Identify threats on the physical components of a system;
- Conduct a reverse engineering of malware to understand their behavior and generate signatures to detect them.

Necessary prerequisites

Good programming skills in C and assembly language;

- A minimum of knowledge about the internals of the OS;
- Bases in algebra and the use of automata theory.

Practical info

Location(s)

Toulouse

Networks and protocols security

ECTS
3 crédits

Hourly volume
40h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- the main concepts of network security, main threats targeting these networks and associated protection mechanisms
- the main concepts of non wired network security (Wifi, GSM, GPRS, LTE, UMTS)
- the main weaknesses of the network protocols and how to eliminate these weaknesses

The student will be able to:

- Understand and carry out basic networks attacks in the context of intrusion tests ; identify and imlement protection mechanisms mitigating these attacks, use and install protection infrastructures
- Choose a security solution dedicated to a Wifi access point; carry out intrusion tests on an access point
- Distinguish the security objectives in different cellular networks ; describe authentication mechanisms and key exchange protocols ; describe the different attacks targeting these different technologies ; identify the architectural components of security in operator networks
- Identify the weak protocols currently used in networks ; propose solutions for these weaknesses, through the use of tunnels when this is necessary ; use SSH and its associated functionnalities (file transfers ,proxies, etc) ; describe the good practices for the definition of a secure network protocol

Necessary prerequisites

Knowledges and skills in computer networks and the underlying protocols are required (TCP/IP, routing protocols). The corresponding terminology must be known and the main concepts of cryptography must be clearly understood.

Practical info

Location(s)

Toulouse

Architectures of secured networks

ECTS
4 crédits

Hourly volume
54h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The main concepts associated to the design and the implementation of secure network architectures
- The main tools and technics allowing to implement protection measures, and their usage according to the different contexts and objectives
- The vulnerabilities inherent in system architectures and network and major intrusion techniques;
- The operation of the main vulnerabilities of the web.

The student will be able to:

- Identify the different classes of firewalls as well as their functionalities and weaknesses
- Define and audit a filtering architecture dedicated to a specific network
- Choose, for an IPSEC tunnel, the correct protocols, the correct execution modes and a routing plan adapted to the associated gatewaus
- Implement and audit such an IPSEC tunnel
- Deploy and audit a VPN based on IPSEC, either by configuring ¿by hand¿ the VPN or by using all-in-one preconfigured tools available
- Deploy and audit a network intrusion detection system (or intrusion prevention system)
- Design a complete security architecture for a complex network
- Identify the advantages and limitations of different intrusion detection solutions;
- Position the intrusion detection sensors efficiently;
- Analyze the events collected by the sensors and correlate these events to identify a real threat.
- Identify vulnerabilities in web architectures and propose solutions to achieve effective protection.

Necessary prerequisites

Good knowledge of web architectures, cryptography and networks.

Practical info

Location(s)

Toulouse

[FRANCAIS] Sécurité des systèmes embarqués critiques

ECTS
5 crédits

Hourly volume
31h

Introducing

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The different techniques used today to secure ground / air communications with satellites;
- Issues related to different types of mission and standards used;
- The means for securing transmissions spread spectrum (TRANSSEC);
- The principles of the computer network for air traffic management (ATM) and related security issues;
- The principles and issues of security management in the context of the DGAC.

The student will be able to:
- Make relevant choice for securing ground / air communications architectures;
- Perform a black box analysis of a critical embedded system

Practical info

Location(s)

Toulouse

[FRANCAIS] SHSJ

ECTS
5 crédits

Hourly volume
42h

Practical info

Location(s)

Toulouse

[FRANCAIS] UE commune M2 RT

ECTS
9 crédits

Hourly volume
45h

Practical info

Location(s)

Toulouse

Training period 4th year

ECTS
9 crédits

Hourly volume

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Training period 5th year

ECTS
21 crédits

Hourly volume

Practical info

Location(s)

Toulouse