INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES RENNES

Academic year 2020/2021

Courses offered by the programme

Informatique (INFO)
Computer Science

Semester(s) : 7-8-9-10

Curricula are organized in groups of courses (Unités d'Enseignement (UE)), consisting of several courses (Eléments Constitutifs (EC)). An EC is a teaching module including lectures (cours magistraux (CM)), tutorials (travaux dirigés (TD)), laboratory work (travaux pratiques (TP)), projects (PR), conferences (CONF), personal work (TA) and possibly other pedagocial activities (DIV). Some internships (stages (ST)) are compulsory

Commonly used abbreviations
CM : Lectures
TD : Tutorials
TP : Laboratory Work
CONF : Conferences
TA : Personal Work
PR : Project
ST : Internship
DIV : Miscellaneous

Code	Libelle
INFT1-SPECIF	Formal Specification
INF07-CRYPTO	Cryptography Engineering
INF07-PERF	Performance evaluation
INF07-PP	Parallel programming
INF07-PROJ1	Project: Preliminary Study and Specifications
INF08-CLOUDS	Clouds
INF08-CONTR	Constraint Programming
INF08-PRGSECU	Secure programming
INF08-PROJ2	Project: Design and Implementation
INF08-TALIL	NLP and language-based interactions
INF09-BDASW	Advanced Databases and Semantic Web
INF09-CCU	User-Centered System Design
INF09-CP	Competitive programming
INF09-DATA	Storage at large scale
INF09-DevOps	DevOps
INF09-SECU	Side channel attacks

List of courses with handout in English or that can be taught in English

Object Oriented Programming	INF07-CPP
Number of hours : 26.00 h	2.50 ECTS credit
CM : 16.00 h, TP : 10.00 h	
Reference Teacher(s) : ANQUETIL ERIC	

Objectives :
Object-oriented programming is a powerful tool to cope with the development of real applications. It helps to define projects with an effective monitoring of the different phases of evolution. This course emphasizes the fundamental principles associated with object-oriented programming. It is performed in parallel with the object modeling module (INF07-MODEL) to fully understand all aspects of the notion of "object": Analysis, Design and Object Oriented Programming.
The two main languages ??presented in this course are: C + + and JAVA. C + + is presented from basic concepts to more advanced concepts. Only the most advanced concepts of the Java language are explored in detail, in addition to the introductory course in Java provided in the module pre-specialization semester (S4). This course also includes an awareness of UI development in DotNET (WPF and C #).
This module consists of 24 hours of courses and 7 hours of TPs._In parallel with this course, students will conduct a tutored project (see INF07-TPCPOO) in pairs to acquire in the context of a project-based teaching the theoretical statements of the course.

Content :
Object-oriented programming in C++.
* Notion of object in C++: Construction of objects, Interfaces, Encapsulation, etc.
* Memory management : Dynamic memory allocation, Destructor, Assignment statement..
* Basic elements of C++: Input/Output management, String, etc.
* Object conception in C++: Aggregation, Inheritance, Polymorphism, Access control, etc.
* Multiple inheritance / Template.
* STL.

Introduction of new object oriented programming concepts in Java.
* Streams.
* Serialisation.
* Generics.

#Conception and advanced programming in Java and C++.
* Exceptions handling.
* RTTI.
* Internal class.
* Design Pattern implementation.
* Programming and use of frameworks.
* DotNET, .wpf and MVVM IHM programming
* Java Native Interface (JNI).

Bibliography :
* Conception orientée objets et applications- G. Booch - Addison-Wesley
* The C++ programming language (third edition) - B. Stroustrup - Addison-Wesley
* Thinking in Java - Bruce Eckel

Requirements :
Basic understanding of algorithmics.
C programming and basic object-oriented programming in Java (see the "introduction to object oriented programming in Java"
module taught as part of the prespecialisation course).

Organisation :
Revision of class notes (1h per week)

Evaluation :
Two-hour written examination at the end of the semester.

Target :

Object-Oriented Design and Programmation #2	INF07-CPOO2
Number of hours : 22.00 h	3.00 ECTS credit
CM : 12.00 h, TD : 10.00 h	
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
The creation of software systems requires to consider in advance the development problems software engineers will face to limit development errors and cost.
Various object-oriented development problems have been already identified and generic solutions exist to speed up the development, limit errors, and ease the communication between software engineers. This is design patterns. In this class, we will study with a critical and modern point of view mainstream design patterns. Demonstrations in different programming languages will be done (Java, Scala) to study how the design patterns can be implemented, naturally or not, in different languages. We will introduce advanced object-oriented programming concepts (class vs prototype, typing systems, trait, object-oriented lambda expression, etc.). The class will use basic concepts of object-oriented modelling with UML.

Content :
* Object-oriented modelling, advanced object-oriented programming
* Design pattern

Bibliography :

Requirements :
Good knowledge in object-oriented programming (e.g. Java)
Good knowledge in object-oriented modelling (e.g. UML)

Organisation :
Class / demo, practical sessions

Evaluation :
Two-hour exam on table, documents allowed.

Target :
4INFO

Object-Oriented Design and Programming Project	INF07-PROJ-CPOO
Number of hours : 16.00 h	2.00 ECTS credit
EP : 16.00 h	
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
The concepts covered during the CPOO2 classes are used through a development project. This project focuses on developing technical skills in: software modelling; software development; DevOps; Web development. The project also aims at developing projects management skills.

Content :
* Object-oriented modelling, advanced object-oriented programming
* Design pattern
* Web development
* DevOps: continuous integration, automation, software testing, continuous deployment

Bibliography :

Requirements :
Good knowledge in object-oriented programming (e.g. Java)
Good knowledge in object-oriented modelling (e.g. UML)
Good knowledge in software testing (JUnit)
Good knowledge in Web development (backend, front-end, REST)

Organisation :
practical sessions (project)

Evaluation :
Development project

Target :
4INFO

Operating System	INF07-SYST
Number of hours : 54.00 h	4.00 ECTS credit
CM : 16.00 h, TD : 16.00 h, TP : 20.00 h	
Reference Teacher(s) : BERTIER MARIN	

Objectives :
* How operating-system resource management mechanisms function. This makes operating system usable for conception and
application programming.
* The concept of parallelism is essential.
* The concepts of process and threads, synchronization mechanisms and Input/Output are presented.
* Practical work enables students to understand how to use process-management mechanisms for applications.

Content :
* Introduction to operating systems.
* Process life cycle. Representation/creation.
* Process Synchronisation. Deadlocks.
* Input/Output. Tubes and files.
* Multithreading.
* Synchronisation.
* Object conception in a parallel framework.
* Virtual machines.
* SMP. Multicores. GPU. Hyperthreading.

Bibliography :
Griffiths : Architecture des systèmes d'exploitation - Hermès Krakowiak : Principes des systèmes d'exploitation des ordinateurs
- Dunod Tanenbaum : Les systèmes d'exploitation - InterEditions Tanenbaum : Systèmes d'exploitation. Systèmes centralisés, systèmes distribués - InterEditions Camillerapp : Systèmes - Notes de cours, polycopié INSA

Requirements :
Module on Computer Architecture.

Organisation :
Revision of class notes. Preparation of exercises and oral examinations. Practical work tasks.

Evaluation :
* A three-hour written examination (with documents) at the end of the semester.
* Mark for practical work.

Target :

Stochastic model	INF07-MSTOC
Number of hours : 26.00 h	2.50 ECTS credit
TD : 26.00 h	
Reference Teacher(s) : LEGUESDRON Abdelly	

Objectives :
The study of one particular category of stochastic model: Markov chains.
Markov chains distinguish themselves from other models by the fact that their evolution in time depends only on the present and not on the past.
Markov chains are used for modelling a number of queuing phenomena, especially those that concern computer system applications.
Examples and applications deal mostly with this domain.

Content :
* Discret-time Markov chains: Transition probability matrix. Transition diagram. The Chapman-Kolmogorov equations. State classification. Recurrence and transience. Ergodics. Asymptotic behaviour.

* Continuous-time markov chains: Transition probability. The Chapman-Kolmogorov equations. Infinitesimal generator. Transitory regime. State classification. Asymptotic behaviour.

* Examples of processes: Birth and death process. Poisson process.

* Application to queuing phenomena: Queues M/M/1. M/M/s. M/M/infinite. M/M/s/s.

Bibliography :
* W. Feller. Introduction to Probability Theory and its Applications, Vol. I et II, J. Wiley and Sons, 1971
* Vidyadhar G. Kulkarni. Modeling and Analysis of Stochastic Systems. Chapman et Hall, 1995
* Averill M. Lad, W. Davis Kelton. Simulation Modeling et Analysis. 2nd Edition, , McGrall-Hill Int. Editions, 1991
* J. Medhi. Stochastic Models in Queueing Theory. Academic Press, 1991
* A. Ruegg. Processus stochastiques (tome 6). Presses polytechniques romandes
* K. S. Trivedi. Probability and Statistics with Reliability, Queueing and Computer Science Applications. Prentice-Hall, 1982.

Requirements :
Mathematical courses from the undergraduate program of INSA (years 1-2) or equivalent skills

Organisation :
13 sessions of courses/directed work.

Evaluation :
Two-hour examination at the end of the semester.

Target :

Formal Specification	INFT1-SPECIF
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : DUCASSE MIREILLE	

Objectives :
A terme, le génie logiciel pourra difficilement s'envisager sans méthode formelle. Les logiciels ayant de plus en plus de responsabilités (en vies humaines, économiques planétaires, etc), leur qualité ne pourra plus souffrir l'à peu près. Les méthodes formelles demandent des bases théoriques qui sont difficiles à acquérir en entreprise.

It is difficult to picture software engineering without the use of formal methods. Software applications are becoming increasingly involved in activities with large-scale responsibilities. They can for example impact human lives or the global economy. Software engineers must therefore be able to guaranty the quality of the produced softwares. Formal methods require theoretical bases, which are hard to acquire through work-experience alone; therefore, their introduction is considered a fundamental feature of the computer science curriculum.
This module is based on the B method developed by J.R. Abrial. It has numerous advantages. It is close to object-oriented programming. The theory behind it, although generous, is rather simple. It is based essentially on first-order logic and set theory. The B method has the advantage of being both state-of-the-art and already proven in practice for critical software development, as seen at RATP, the major transport operator for the Paris area.

This course focuses on the formal specification aspect of the B method. Indeed, this aspect requires abstraction work that is cognitively difficult and sparsely addressed in other modules, whereas aspects related to programming are close to methods addressed in many other courses.

At the end of the course, students are able to specify simple case studies and they can validate the correction of these specifications with respect to an invariant that specifies the contract to fulfil. They have acquired the foundation for further study of formal methods.

Content :
* Brief overview of the B method: Invariant, Abstract Machine, Refinement, Implementation, Proof Obligation
*Specification language: Generalized Substitutions, Sets, Functions and Relations,
* Case Studies

Bibliography :
* Assigning programs to meanings, the "B" Book, Jean-Raymond Abrial. Cambridge University Press, 1996.
* Introduction à la spécification, Henri Habrias. Masson éditeur, Collection "Méthodologies du Logiciel," 1993.
* Introduction to the B Method. Course hand-out (in English), Mireille Ducassé, INSA Rennes. (Updated every year and distributed to students.)

Requirements :
* Good knowledge of first order Logic and of proof mechanisms in that logic.

Organisation :
- Organisation: 14h of lecture and 12h of class work sessions (TD).
- Personal work: Revision of lecture notes. Preparation of lecture summary. Preparation of exercises for class work.

Evaluation :
* 9/10 of final grade: Two-hour written examination, at the end of the semester, without access to documentation except for the booklet collecting all the notations distributed at the beginning of the module.
* 1/10 of final grade: Lecture summaries, produced as homework and handed at the beginning of the next lecture.

Target :
Students wanting to investigate a rigorous and safe way of programming.

Internet of Things	INFT1-IOT
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, EP : 6.00 h, TA : 2.00 h, TP : 2.00 h	
Reference Teacher(s) :	

Objectives :
Introduction to the Internet of Things

Content :
(subject to change)

* Introduction to the Internet of Things
* Networks for IoT
* Operating Systems for IoT
* IoT and Big Data
* IoT, security and privacy
* IoT and healthcare
* IoT and home automation

Bibliography :

Requirements :
Basic knowledge in operating systems, networks and algorithms

Organisation :
Course, conferences and lab works in small groups for working with innovative devices

Evaluation :
Continuous review

Target :
5th year students

Optimization	INFT1-OPT
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 10.00 h, TP : 4.00 h	
Reference Teacher(s) :	

Objectives :
Overview of the problems and methods related to optimisation. Focus on continuous optimization. Introduction to Linear integer programming.

Content :
* Introduction and examples, Linear programming.
* Unconstrained optimisation: Optimality conditions. Gradient method. Nexton method.
* Constrained optimization: Optimality conditions. Feasible methods. Penalty methods.
* Introduction to Linear Integer programming.
* "Branch and bound" algorithms. Lagrangian relaxation methods.

Bibliography :
"Programmation mathématique" - M. MINOUX
"Méthodes d'optimisation combinatoire" - A. GERMA, O. HUDRY
"Optimisation numérique. Aspects théoriques et pratiques" - J.F. BONNANS, J.C. GILBERT, C. LEMARECHAL, C. SAGASTIZABAL

Requirements :
Basics of analysis and linear algebra.

Organisation :

Evaluation :
Two-hour examination at the end of the semester.

Target :

Image and video analysis	INF07-TIV
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TP : 14.00 h	
Reference Teacher(s) : BABEL MARIE	

Objectives :
This module aims at introducing basic notions related to image and video analysis.
Image and Video Processing is a largely studied domain of Computer Science with various applications: computer vision, pattern recognition, indexation, robotics....
The lectures aims at giving a summary of this subject and particularly focuses on the main line of detecting objects or symbols in images and videos. Therefore, the main knowledge leading to this end are exposed: from early vision given by basic digital processing, via features extraction from images, and segmentation.

Content :
- Introduction to image and video processing : acquisition, HVS
- Basic image processing tools: filtering, spectral analysis, histograms
- Image segmentation and visual feature extraction
- Video segmentation: application to object tracking

Bibliography :

Requirements :
Object-oriented programming
Linear algebra
Data analysis

Organisation :
This module is organized as follows: 12h of plenary lectures and 14h of practical sessions including 8h of project session.

Evaluation :
Pratical work (project)

Target :
4INFO

Computer graphics	INF07-IG
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TP : 14.00 h	
Reference Teacher(s) :	

Objectives :
* Learning the basic operations to design 2D and 3D interactive graphic scenes
* Modeling, animating and interacting with 3D virtual worlds

Content :
* Modeling: data structures to represent 2D and 3D scenes (meshes, curves and surfaces)
* Rendering: designing 2D images from 3D models, rendering methods, illumination and textures
* Animation: dynamic simulation of 3D objects, procedural animation and introduction to physics-based models.

Bibliography :
* OpenGL Programming Guide. J. Kessenich, G. Sellers, D. Shreiner. Ed. Addison Wesley.
* Fundamentals of Computer Graphics. P. Shirley, M. Ashikhmin, S. Marschner. Ed. AK Peters/CRC Press.
* Computer Graphics: Principles and Practice. J. Hughes, A. van Dam, M. McGuire, D. Sklar, J. Foley, S. Feiner, K. Akeley. Ed. Addison Wesley.

Requirements :
* Basis of geometry
* C++ programming

Organisation :
The course combines both theoretical lectures illustrated through examples with practical courses and a project.

Evaluation :
Practical courses and project.

Target :
Engineer in Computer Science

Computer network security	INF07-SECU
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : AVOINE GILDAS	

Objectives :
Understand in depth the security issues in computer networks and the technical countermeasures to consider to mitigate the issues.

* Teachers : Gildas Avoine, Marin Bertier, Olivier Le Brun

Content :
* Network Attacks (TCP Hijacking, IP Spoofing, ARP Spoofing, SYN Flooding)
* Firewalls (Architectures, Rules, NAT,...) and proxies
* Intrusion Detection Systems
* Tunnels (SSH, SSL, IPSec)
* WiFi Security

Bibliography :
Sécurité informatique, Cours et exercices corrigés, Gildas Avoine, Pascal Junod, Philippe Oechslin, and Sylvain Pasini, 2015 (3è édition), 384 pages, ISBN : 978-2-311-40168-4. The second edition is outdated but available in English.

Requirements :
Knowledge in computer networks (layered model, protocols ARP, IP, TCP/UDP, DHCP, DNS, router, switch, hub)

Organisation :
Ex-cathedra lectures, exercises sessions, practical sessions. A teacher from the École des transmissions (ETRS) of the ministery of defense will teach the firewalls during 10 hours.

Evaluation :
- A two-hour practical session (3points)
-A two-hour written examination based on the content of the lectures, exercises, and practices. Documents, personal notes, and electronic devices are not allowed during the examination (17 points)

Target :

Cryptography	INF07-CRYPTO
Number of hours : 26.00 h	2.00 ECTS credit
CM : 20.00 h, TP : 6.00 h	handout in English
Reference Teacher(s) : AVOINE GILDAS	

Objectives :
Introduction to cryptography, presentation of fundamentals, and study of current standards.

Content :
* Cryptography History
* Basics of cryptography
* Certificates
* Authentication protocols
* Examples of poor designs
* Implementation of cryptographic building blocks according to current standards.
* Generation of randomness on a computer

Bibliography :
Handbook of Applied Cryptography, A. Menezes, P. van Oorschot, and S. Vanstone, CRC Press, 1996.
Cryptography: Theory and Practice, Third Edition, D. Stinson, Chapman & Hall, 2005.
The Codebreakers – The Story of Secret Writing, David Kahn, 1967.
The Code Book: The Secret History of Codes and Code-breaking, Simon Singh, 1999.

Requirements :

Organisation :
Ex-cathedra lectures and practical sessions.

Evaluation :
- A continuous assessment based on 3 multiple choice tests. The assessment will be assigned 5 points.
A two-hour written examination at the end of the semester, based on the content of the lectures and practices. Documents, personal notes, and electronic devices are not allowed during the examination. The written examination will be assigned 15 points.

Target :

Parallel programming	INF07-PP
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 12.00 h	course taught in English
Reference Teacher(s) : PAZAT JEAN-LOUIS	

Objectives :
Acquire knowledge in Parallel and Distributed Computing methodologies

Content :
- Introduction to parallel computing
- Tools and methodologies for synchronization of mufti-threaded programs
- Data Parallelism and GPU
- Distributed Computing
- Workflows

Bibliography :

Requirements :
- C-programming
- Basic knowledge on multithreading and synchronization
- Linux basic knowledge

Organisation :
Course and exercices, lab works with workstations and cluster

Evaluation :
Written examination (2hours)

Target :
4th year students computer science/software engineering (graduate level)

Performance evaluation	INF07-PERF
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TP : 14.00 h	hand-out in English and course taught in English
Reference Teacher(s) : PARLAVANTZAS NIKOLAOS	

Objectives :
This course aims to present the key concepts and methods for evaluating the performance of computer systems. The course focuses on practical techniques and tools that help resolve common performance-related issues, such as avoiding bottlenecks, predicting the performance of different configurations, optimising and sizing systems.

Content :
* Performance modelling (queueing theory, operational analysis, simulation)
* Performance measurement (experiment design, monitoring tools, analysis of results)

Bibliography :
R. Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling," Wiley- Interscience, New York, NY, April 1991, ISBN:0471503361.

Requirements :
Basic understanding of operating systems

Organisation :

Evaluation :
Written examination and project

Target :

Project Management for computer science	INF07-GEST
Number of hours : 16.00 h	1.00 ECTS credit
CM : 8.00 h, DIV : 4.00 h, TD : 3.00 h	
Reference Teacher(s) : ANQUETIL ERIC	

Objectives :
"There can be no project without project management ". This is an important part of the engineer activity. With the increasing of responsibilities, this activity becomes even preponderant. It is therefore essential to know what it covers.
We will study who the players are, what the project steering activities are: communication aspects, management, risk, quality ... We will include a focus on:
* Identification of activities;
* The product/project life cycle...
* The Agile methods used on innovative projects ...
* The estimation and project planning process

Content :
Speakers: Industrial specialist in project management

We study in this module methods and approaches by declining them on each student project (INF07-PROJ1 module). Among the studied axes we will address in particular:
The communications aspects: meeting organization (daily, weekly ...), handling objections, conflicts and negotiations ...
The product life cycles: determining the "product" cycle of the projects, subprojects, tasks (expected deadlines), workflow identification (incoming, outgoing), critical path / margin, deterministic strategy, level of confidence, evaluation approaches...
The risk management, product requirements ...
Time management

Bibliography :
A Bibliography is proposed by industrial speaker.

Requirements :
To attend to the INF07-PROJ1 module.

Organisation :
This module consists of both theoretical and practical work applied directly on each project of each student groups (see INF07-PROJ1 module). This module will help students to build a robust detailed planning of their project.
We will also take in hand the MS Project management software to develop the initial project planning.

Evaluation :
Students have to make several deliverables (reports and oral presentations) which are evaluated by the teachers of this module. These report and oral presentation will be based directly on the specific project of each student group:
Identification of resources: Human or others in the team or outside
Identification and risk management, confidence level
Organization in phases / projects
Life cycle presentation
Product/Project/Subproject overview (WBS Decomposition - PERT scheduling ...)
Planning from MS Project: workload estimate, duration ...

Target :

Project: Preliminary Study and Specifications	INF07-PROJ1
Number of hours : 33.00 h	2.50 ECTS credit
EP : 30.00 h, EP : 3.00 h	course taught in English
Reference Teacher(s) : ANQUETIL ERIC	

Objectives :
The goal of the project is to initiate students to work in team (5-7 students / project) on a significant achievement (1500h / project). The project is tutored. The aim is to implement a number of methods of software engineering and project management as seen through the courses associated with this module (a course of 10 hours of project management is included in this module)._Essential educational objectives are:_Introduction to team work, use of methods and software engineering tools, time management, planning, communication, phases of analysis, specification, implementation and validation, technical Reading, Writing Technical Reports , Acquisition of presentation skills.

Content :
The first semester is devoted to the study of the scope and definition of the functional specifications of the software. It will conclude with an initial project planning. It will establish the roadmap : organization, distribution, and synchronization tasks, indicators, time-constraints, etc.

Bibliography :
* Peopleware, Productive projects and team. T. DeMarco et T. Lister. Dorset House Publishing Co. 1987.
* Cas pratiques de conduite de projets. P.T. Quang et J. Joskowicz. Eyrolles, 1993.

Requirements :
Project 2 follows in the second semester.

Organisation :
Students are expected to invest a great deal of time in this project.

Evaluation :
Towards the end of December, each project group hands in two reports containing the domain study and the functional analysis._A presentation is given at the end of the semester during which the essential report results are presented in front of a panel of three judges composed of the group's project manager (Teacher), report reviewer and another project supervisor.

Target :

Industrial conference S7	INF07-CONF
Number of hours : 15.00 h	0.50 ECTS credit
CONF : 6.00 h	
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
Conferences are done by industrial contributors, on different subjects like:

- Vocal technologies and sound processing. Where are we now?
- Scrum method & CMMI
- How advance and take responsibilities with a computer science master degree?
- Working abroad / Understand and adapt to cultural differences

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

English	HUM07-ANGL
Number of hours : 28.00 h	2.00 ECTS credit
TD : 28.00 h	
Reference Teacher(s) : RANNOU ISABELLE	

Objectives :
Acquiring the required skills for working in a firm as an engineer. Reaching the required level (B2) is compulsory in order to graduate.

Content :
-Learning by doing:
The student will have to be able to talk and listen, write documents while showing he/she can solve problems, reason, convince and demonstrate in an articulate manner.
-Expressing oneself accurately and fluently.
The student will engage in activities requiring creative and reactive skills (such as debates, role-plays, individual oral presentations using PowerPoint, projects), which will be based on scientific topics and current events.
-Writing CVs and cover letters
-Scientific English
-Discovering the professional world in an international context
-Preparing for the TOEIC (during the second semester, a specific ¿Toeic Booster¿ course will be available)

Bibliography :
- Oxford Advanced learners¿ Dictionary
- English Grammar in Use (Cambridge University Press)

Requirements :
1st, 2nd and 3rd year English courses (or equivalent)

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia language lab and computer rooms are also available and make it possible for the students to work in a stimulating environment. Our teaching resources include press articles, audio and video documents (TV reports, extracts from films and series). We also use the Internet.
Regular personal work is obviously required. The student must be curious and practise English outside the classroom as well.

Evaluation :
One two-hour written exam.

Target :

Entrepreneurship and Innovation	HUM07-EI
Number of hours : 48.00 h	3.00 ECTS credit
CM : 24.00 h, TD : 24.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Sport and physical education	HUM07-EPS
Number of hours : 24.00 h	1.00 ECTS credit
TD : 24.00 h	
Reference Teacher(s) : LE LAGADEC PIERRE	

Objectives :
Team work, discovery of one's capabilities, communication, invention and management responsibilities.

Content :
Choice of two activities from a menu. Adapting to destabilising situations and taking responsibility when risk is involved.
Speaking to groups. Leading group stretching exercises. Indoors: Rock climbing or badminton in teams. Outdoors: C.O or
Kayak or golf

Bibliography :
Several specialized books are available to the students at the library. Links to internet sites are given on the EPS website.

Requirements :

Organisation :

Evaluation :
Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

2nd Year Work Placement	EII05-STA2-4
Number of hours : 240.00 h	4.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

2nd Year Work Placement	GCU05-STA2-4
Number of hours : 240.00 h	4.00 ECTS credit
CONF : 0.00 h, DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

2nd Year Work Placement	GMA05-STA2-4
Number of hours : 240.00 h	4.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Stage 2e année 4cr	INF05-STA2-4
Number of hours : 240.00 h	4.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Stage 2ème année	ARO05-STA2-4
Number of hours : 240.00 h	4.00 ECTS credit
DIV : 0.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 8

Parcours Formation Initiale INFO

1	**INF08-1**		**Software Engineering**	**6.50**
	INF08-GRL	O	Grammars and Languages	2.50
	INF08-COMPIL	O	Compilation	2.00
	INF08-CONTR	O	Constraint Programming	2.00
2	**INF08-2**		**Projects and opening course**	**5.50**
	INF08-PROJ2	O	Project: Design and Implementation	3.00
	INF08-CONF	O	Industrial conference S8	0.50
	INFT2-IA	C	Artificial Intelligence	2.00
	INFT2-PM	C	Mobile programming	2.00
	INFT2-ROBO	C	Robotics	2.00
3	**INF08-3**		**Options**	**4.00**
	INF08-RIV	C	Recognition and Interpretation of Images and Videos	2.00
	INF08-TALIL	C	NLP and language-based interactions	2.00
	INF08-PRGSECU	C	Secure programming	2.00
	INF08-CLOUDS	C	Clouds	2.00
4	**INF-STAGE08**		**Work placement**	**8.00**
	INF08-STAGE	O	Summer Work Placement	8.00
5	**HUM08**		**Non-scientific syllabus S8**	**6.00**
	HUM08-ANGL	O	English	2.00
	HUM08-ECO	O	Economy and Management	1.00
	HUM08-SHES1	O	Engineer & Society - M1	1.00
	HUM08-SHES2	O	Engineer & Society - M2	1.00
	HUM08-EPS	O	Sport and Physical Education	1.00

O = compulsary, C= in choice , F= optional

Grammars and Languages	INF08-GRL
Number of hours : 32.00 h	2.50 ECTS credit
CM : 16.00 h, TD : 16.00 h	
Reference Teacher(s) : FILA BARBARA	

Objectives :
A study of regular and context-free languages with their closure properties. Various description approaches are used: grammars, automata, regular expressions, system equations. A thorough knowledge of these description models enables the most appropriate choice for developing description of translation programs.

Content :
* Mathematics preliminaries
* Regular languages and finite state machines
* Regular expressions
* Context-free grammars
* Context-free languages
* Pushdown automata
* Synthesis

Bibliography :
"Langages algébriques", Jean-Marie Autebert, Masson, 1994.

"Introduction to the theory of Computation", Michael Sipser, 1997.

Requirements :
No prerequisites

Organisation :
Studying course work and preparing tutorials (2 hours per week)

Evaluation :
Two-hour written examination

Target :
4INFO

Compilation	INF08-COMPIL
Number of hours : 30.00 h	2.00 ECTS credit
CM : 10.00 h, TP : 20.00 h	
Reference Teacher(s) : GARCIA PASCAL	

Objectives :
* A compiler is a programme which takes as input another program in a source language and which transforms it into an
equivalent program in a target language.
* The notion of "programme" has to be understood in a broad sense. It may be a text
containing formatting instructions or an executable programme.
* The objectives of compilation at large can be numerous: text formatting, executable code generation, programme analysis, debugging, testing, etc.
* The aim of the 4th year compilation course is to give students the tools to detect and evaluate a compilation problem. In particular, error and ambiguity detection and recovery are emphasised.
* The course takes advantage of the practical experience of the students, and tackles the clarification of concepts and presentation of basic techniques in perspective.
* Laboratory work enables students to understand the implementation techniques.
* Programming is carried out in ML, a declarative language well suited to compiler implementation.
* Automatic code generator tools such as Lex and Yacc are introduced and used at the end of the course.
* A compilation exercise is also done during Prolog Laboratory work.

Content :
* Compilation stakes.
* Lexical analysis.
* Syntactic analysis: Descendant analysis LL(1) and LL(k). Ascendant analysis LR, SLR, LALR.
* Semantic analysis: Attributed grammars, Dataflow Analysis, Milner Type inference.
* Code generation : Register allocation, Garbage collection.

Bibliography :
Les compilateurs - théorie, construction, génération. R. Wilhelm et D. Maurer, Masson, 1994.
Compilateurs - Principes, techniques et outils, A. Aho, R. Sethi et J. Ullman, InterEditions, 1989.
Compilation - Support de cours. M. Ducassé, INSA de Rennes, mis à jour tous les ans.

Requirements :
Modules on grammars and languages.

Organisation :
Revision of class notes. Preparation of laboratory work assignments.

Evaluation :
Three-hour closed-book, written examination at the end of the semester.
Assessment of laboratory work.

Target :

Constraint Programming	INF08-CONTR
Number of hours : 26.00 h	2.00 ECTS credit
CM : 10.00 h, TP : 16.00 h	hand-out in English and course taught in English
Reference Teacher(s) : DUCASSE MIREILLE	

Objectives :
Many difficult problems of everyday life are known as "constraint problems", for example timetable making or resource allocation. These problems are highly combinatorial. To automate their resolution one should use appropriate tools. Indeed, programming with traditional languages requires the programmer to manage an important complexity. Programming is difficult, the response time and the needed computational resources quickly become unbearable.

Constraint programming uses constraint solvers. The solvers support a large part of the complexity of the problems. However, their use is difficult, it requires a good knowledge base and specific expertise. This module lays the first foundations for constraint programming in the context of logic programming.

Content :
* Introduction to Constraints
* From Prolog to Constraints
* Finite Constraint Domains
* Programming with Finite Domain Constraints
* Examples of Applications

Bibliography :
* Programming with constraints. An introduction, Kim Marriott and Peter J. Stuckey, MIT Press, 1998. Programmation
* Constraint logic programming using ECLiPSe, Krysztof R. Apt and Mark G. Wallace, Cambridge University Press, 2007
* Constraint (Logic) Programming, Mireille Ducassé, Lecture and Labs Hands-out, updated every year.

Requirements :
Practical experience of Prolog programming.

Organisation :
Organization : 10h of lecture, 16h of labs.

The lecture hands-out are in English. The ECLiPSe-Prolog environment is used for the labs.

Personal work : Revision of lecture notes. Preparation of labs (two hours per week).

Evaluation :
Two-hour written examination at the end of the semester, without access to documentation except an A4 hand-written sheet.

Target :

Project: Design and Implementation	INF08-PROJ2
Number of hours : 60.00 h	3.00 ECTS credit
EP : 60.00 h	course taught in English
Reference Teacher(s) : ANQUETIL ERIC	

Objectives :
The goal of the project is to initiate students to work in team (5-7 students / project) on a significant achievement (1500h / project). The project is tutored. The aim is to implement a number of methods of software engineering and project management as seen through the courses associated with this module (a course of 10 hours of project management is included in this module)._Essential educational objectives are:_Introduction to team work, use of methods and software engineering tools, time management, planning, communication, phases of analysis, specification, implementation and validation, technical Reading, Writing Technical Reports , Acquisition of presentation skills.

Content :
The second semester is dedicated to the design, realisation, validation and delivery of the project. Students are given a three-week period, during which no other modules are taught, in order to facilitate the projects. The teacher assumes the role of project manager. Meetings between the project manager and the students take place every week.

Bibliography :
* Peopleware, Productive p rojects and team. T. DeMarco et T. Lister. Dorset House, Publishing Co. 1987.
* Cas pratiques de conduite de projets. P.T. Quang et J. Joskowicz. Eyrolles, 1993.

Requirements :
Project 1 (first semester).

Organisation :
During the second semester every student is assigned a list of tasks to accomplish._Task monitoring sheets must be filled in, enabling the project manager (Teacher) to oversee progress and establish objectives_on a weekly basis.

Evaluation :
Students deliver several reports: a report containing the applications design specifications and a global description of its implementation; online documentation of the application; a report containing the test phases, the user manual and the project management balance sheet; two HTML pages, one in French and the other in English, containing a global description of the project.
An oral presentation takes place at the end of the semester during which students outlay the results of their projects before a jury comprising the project manager (Teacher), a critic and an observer. The students are charged with demonstrating the operational functionality of the software including quality and validity of tests.

Target :

Industrial conference S8	INF08-CONF
Number of hours : 12.00 h	0.50 ECTS credit
TD : 12.00 h	
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- Computer science in the financial world
- Startup creation
- Conception user-oriented
- Introduction to Corporate Information Systems
- Complex projects management
- Continuous integration

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

Artificial Intelligence	INFT2-IA
Number of hours : 26.00 h	2.00 ECTS credit
CM : 8.00 h, TP : 18.00 h	
Reference Teacher(s) : GARCIA PASCAL	

Objectives :
Solving complex problems with application to game.

Content :
Uninformed search
Minimax alpha beta with transposition tables Monte-Carlo Tree Search
Genetic algorithms
Neural networks

Bibliography :
Articles

Requirements :
Java

Organisation :

Evaluation :
Project

Target :
3INFO et 4INFO

Mobile programming	INFT2-PM
Number of hours : 26.00 h	2.00 ECTS credit
CM : 2.00 h, TP : 24.00 h	
Reference Teacher(s) : ROZE MARCHAND LAURENCE	

Objectives :
The objective of this module is to practice Android programming to the development of mobile applications that can run on various devices. The core concepts of Android programming will be discussed, such as activity, life cycle of an activity, intention, services, fragments¿

Content :
- the Android mobile programming
- activities
- fragments
- data storage, database
- peripheral, sensors
- service, notification, security
- muli-platform development

Bibliography :
https://developer.android.com/index.html

Requirements :
Object-oriented programming
Knowledge in GUI
The eclipse environment

Organisation :

Evaluation :
* 4-hour practical session

Target :
* L3-M1

Robotics	INFT2-ROBO
Number of hours : 26.00 h	2.00 ECTS credit
CM : 6.00 h, TP : 20.00 h	
Reference Teacher(s) : BABEL MARIE	

Objectives :
This module aims at introducing basic notions related to robotics and computer science thanks to the manipulation of a mobile platform. The software design of such a robotic application relies on mathematical notions dedicated to robot control. In addition, the targeted robotic platform will allow computer science students to discover essential mechatronics elements (odometry, electronic control board, motors…).

Content :
-Introduction to robotics : sensors and actuators, control frameworks, servoing, robust algorithms
-Mobile robotics: software development with GOPIGO mobile platform
-Software design : software platform ROS (Robotic Operating System)
-Sensor-based servoing: line follower, camera, ultrasonic sensors, odometry

Bibliography :
[1] Gregory Dudek and Michael Jenkin. Computational Principles of Mobile Robotics. Cambridge University Press, New York, NY, USA. 2000.
[2] Roland Siegwart and Illah R. Nourbakhsh. Introduction to Autonomous Mobile Robots. Bradford Co., Scituate, MA, USA. 2004.
Several educational materials are available onto GDR Robotique website:
http://www.gdr-robotique.org/cours_de_robotique/

Requirements :
Object-oriented programming
Notions of architecture
Linear algebra

Organisation :
This module is organized as follows: 8h of plenary lectures and 18h of practical sessions. The first lab will be devoted to the assembly of the GOPIGO robot. The last lab session will be as a challenge session where all the robotic systems designed by students will compete in order to realize successive navigation tasks ranging from simple (line following) to complex tasks (collision avoidance).

Evaluation :
Pratical work (project)

Target :

Recognition and Interpretation of Images and Videos	INF08-RIV
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 12.00 h	
Reference Teacher(s) : RICQUEBOURG YANN	

Objectives :
Image Processing and Pattern Recognition is a largely studied domain of Computer Science with various applications.
The lectures aim at focusing on the main line of recognizing symbols in images. Therefore, the main knowledge leading to this end are progressively exposed: based on basic notions from prior lectures (image representation and early vision), it begins with features extraction from images, and finally ends with recognition performed by classifiers.

Content :
The documents are in English.

Part 1: Features
I. Features Detection (locally, low level)
* Edges and Lines
* Keypoints and Corners
* Regions and Blobs
II. Features Extraction (globally or higher level)
* Properties of features
* Geometrical, Frequential, Scale-space Features
III. Feature selection
* Distances, Selection

Part 2: Classification
I. Unsupervised Learning / Clustering
* C-Means, Fuzzy C-Means, Possibilistic C-Means
II. Supervised Learning
* First simple classifiers (k-Nearest-Neighbor...)
* Neural Networks
* MultiLayer Perceptron (MLP)
* Radial-Basis Function Neural Networks (RBFN)
* Evaluation: Reject option, Validation
* Fuzzy Inference System (FIS),
* Dynamic Time Warping (DTW),
* Hidden Markov Models (HMM),
* Support Vector Machine (SVM)
III. Improvement strategies
IV. Example of Pattern Recognition System

Bibliography :

Requirements :
* Basic knowledge on image representation and early vision are advantageous.

Organisation :
* Techniques are exposed in lectures, and are practised during the project along with exploration of new ideas.

Evaluation :
* A practical work on a real-world data set is conducted in parallel of the lecture for the half of the time of the module. The project tends to implement a complete recognition system, gathering students in groups, to have their systems competing each other. Results of each group are presented and evaluated at the end of this module.

Target :
4INFO

NLP and language-based interactions	INF08-TALIL
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 12.00 h	handout in English
Reference Teacher(s) : SEBILLOT PASCALE	

Objectives :
Language, whether written or spoken, is the most commonly used mode for interaction and information transmission.
The goal of this course is to provide students with the necessary knowledge to apprehend how to implement a human-computer interface using natural language and how to access information carried by language within large content repositories.
The course first presents the fundamentals of language understanding in the framework of dialogue interaction. Fundamental notions for speech synthesis and text generation are also apprehended.
Finally, key applications in natural language processing are presented, with the goal of managing, exploring and mining large volumes of language data.

Content :
1) Dialogue and comprehension
- Concept extraction
- Semantic representations
- Dialogue management

2) Synthesis
- Speech synthesis
- Text generation

3) Automatic summarization
4) Structuring documents and collections
- Topic segmentation
- Implicit and explicit linking

5) Analytics
- Sentiment analysis
- Data journalism
- Fact checking

Bibliography :
- M. Agosti, J. Allan. Special issue on methods and tools for the automatic construction of hypertext, Information Processing and Retrieval, Vol. 33(2), 1997
- D. Das, A.F.T. Martins. A survey on automatic text summarization, Rapport technique, Literature Survey for the Language and Statistics II course at Carnegie Mellon University, 2007
- T. Dutoit. An introduction to text-to-speech synthesis, Springer Science & Business Media, 2013
- C. Guinaudeau, G. Gravier, P. Sébillot. Enhancing lexical cohesion measure with confidence measures, semantic relations and language model interpolation for multimedia spoken content topic segmentation, Computer Speech and Language, Vol. 26(2), p. 90-104, 2012
- J. Gray, L. Bounegru, L. Chambers, N. Kayser-Bril (Dir.). Guide du Datajournalisme : collecter, analyser et visualiser les données, sur http://jplusplus.github.io/guide-du-datajournalisme/. Consulté le 3 nov. 2015
- G. Tur, R. De Mori. Spoken language understanding: Systems for extracting semantic information from speech, Wiley Online Library, 2011

Requirements :
Knowledge about machine learning techniques; the 3rd year NLP module

Organisation :
- Hand-out in English and course possibly taught in English
- Need for deepening of the courses, and preparation of practical work

Evaluation :
One 1 hour written examination at the end of the semester, and one practical work.

Target :

Secure programming	INF08-PRGSECU
Number of hours : 26.00 h	2.00 ECTS credit
CM : 13.00 h, EP : 4.00 h, TP : 9.00 h	handout in English
Reference Teacher(s) : FILA BARBARA	

Objectives :
Olivier Levillain (teacher)

At the end of this course, the students will understand the stakes of secure development, as well as common threats. Moreover, they should also develop a critical eye allowing them to adapt their knowledge to new threats.

Content :
This course aims at describing the main categories of software vulnerabilities, at detailing their impact on the security, and at
explaining how to fix the problems. Beyond testing and bug-fixing, the course will also explain how to be proactive to improve the
security during software development.

The course covers the theoretical description of vulnerabilities, concrete examples of software flaws and the presentation of specific and generic countermeasures. Furthermore, the students have several TP sessions, including a graded one; finally, they have to work on a bibliography project.

Bibliography :
There is no required reading before the course, but here are some useful links for the interested students.
- oss-security (http://www.openwall.com/lists/oss-security/) is a mailing list where vulnerabilities and patches concerning open source software are published;
- the CERT-FR web site (http://www.cert.ssi.gouv.fr/) or the corresponding mailing list publishes information on current vulnerabilities, as well as broader documents on cybersecurity news;
- [Memory management flaws] Smashing Stack For Fun and Profit, the historical article describing how to exploit a buffer overflow (http://insecure.org/stf/smashstack.html);
- [Langages] The studies led by ANSSI on programming languages: JavaSec (http://www.ssi.gouv.fr/agence/publication/securite-et-langage-java/) et LaFoSec (http://www.ssi.gouv.fr/agence/publication/lafosec-securite-et-langages-fonctionnels/);
- [Langages] The Mind Your Languages article describing traps in programming languages (http://spw14.langsec.org/abstracts.html#mind). The corresponding course will present examples from the article, as well as new ones.

Requirements :
Basis in programming are required. For the graded TP, the student need to know how to program in a language of their choice (this choice must be validated). Notions of computer architecture will also be useful.

Organisation :
- "cours magistraux" to present theoretical aspects, examples, countermeasures and best practice;
- "TP" to test how flaws work in practice and to learn how to fix them;
- "conferences" on programming languages and on a concrete problem, to give the student some perspective;
- a bibliography project to study a vulnerability or a defense mechanism.

Evaluation :
- a graded TP (coefficient 1), starting with a 4-hour session, followed by some work at home;
- a bibliography project (coefficient 1) in pairs. The goal is to study a vulnerability or a defense mechanism from a security advisory or a blog post. There will be a presentation followed by questions;
- a 2-hour sitting exam (coefficient 1), without computer but with personal notes.

Target :
4INFO

Clouds	INF08-CLOUDS
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TP : 14.00 h	hand-out in English and course taught in English
Reference Teacher(s) : PARLAVANTZAS NIKOLAOS	

Objectives :
This course aims to present the main concepts of cloud computing and to allow students to gain practical experience with modern cloud technologies.

Content :
* Overview of cloud computing
* Virtualisation
* Types of clouds
* Programming models
* Example cloud platforms

Bibliography :
* The Cloud at Your Service, Jothy Rosenberg and Arthur Mateos, Manning Publications, 2010
* Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Prentice Hall, 2013

Requirements :

Organisation :

Evaluation :
Written examination

Target :

Summer Work Placement	INF08-STAGE
Number of hours : 240.00 h	8.00 ECTS credit
ES : 1.00 h	
Reference Teacher(s) : CELLIER-BELLINA PEGGY	

Objectives :
The summer internship takes place in companies or in research laboratories for a period of two or three months. For many students this represents their first job experience. The internship is carried out on an individual basis and many students see it as the first opportunity to assess their capacities in a job directly related to their field of studies. Students must write a report during their internship.

Content :
Examples of previous internship subjects:
* Models for 4D imaging: Life science application in cellular biology.
* Design of a search engine in PHP on MySQL.
* Computerisation of geographic data.
* Improvement of cardiac simulation software.
* CVnet: Human resources management.
* Development of an encryption module using public and private keys.
* Integration of a media synchronisation tool on a videoconferencing platform.
* PC cluster administration tools.
* Achievement of an interactive application for digital television.
* Study and development of a tool for statistical analysis of subscribers in a management system.
* Extension of GCC compiler for code optimisation.
* Creation of software application for security analysis of the bank's computer system.
* Exploitation of test results on a software application to help the air traffic control.

Bibliography :

Requirements :
Students must draw upon their experience of two years specialising in computer science.
Note: The internship usually takes place upon completion of the second year of specialisation and occasionally after one year specialising in computer science.

Organisation :
The student integrates the company on a full-time basis.
Updates to internship report while working at the company leading to finished report.

Evaluation :
Mark awarded by the internship supervisor for work accomplished.
Mark for the report.

Target :

English	HUM08-ANGL
Number of hours : 24.00 h	2.00 ECTS credit
TD : 24.00 h, TD : 24.00 h	
Reference Teacher(s) :	

Objectives :
Acquiring the required skills for working in a firm as an engineer. Reaching the required level (B2) is compulsory in order to graduate.

Content :
-Learning by doing:
The student will have to be able to talk and listen, write documents while showing he/she can solve problems, reason, convince and demonstrate in an articulate manner.
-Expressing oneself accurately and fluently.
The student will engage in activities requiring creative and reactive skills (such as debates, role-plays, individual oral presentations using PowerPoint, projects), which will be based on scientific topics and current events.
-Writing CVs and cover letters
-Scientific English
-Discovering the professional world in an international context
-Preparing for the TOEIC. Furthermore, during the second semester, a specific ¿Toeic Booster¿ course is available for students wishing to attend.

Bibliography :
- Oxford Advanced learners¿ Dictionary
- English Grammar in Use (Cambridge University Press)

Requirements :
1st, 2nd and 3rd year English courses (or equivalent)

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia language lab and computer rooms are also available and make it possible for the students to work in a stimulating environment. Our teaching resources include press articles, audio and video documents (TV reports, extracts from films and series). We also use the Internet.
Regular personal work is obviously required. The student must be curious and practise English outside the classroom as well.

Evaluation :
TOEIC
15 minute oral exam

Target :

Economy and Management	HUM08-ECO
Number of hours : 10.00 h	1.00 ECTS credit
TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Engineer & Society - M1	HUM08-SHES1
Number of hours : 14.00 h	1.00 ECTS credit
TD : 14.00 h, TD : 14.00 h	
Reference Teacher(s) : ECHARD PHILIPPE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Engineer & Society - M2	HUM08-SHES2
Number of hours : 14.00 h	1.00 ECTS credit
CM : 14.00 h, CM : 14.00 h	
Reference Teacher(s) : ECHARD PHILIPPE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Sport and Physical Education	HUM08-EPS
Number of hours : 20.00 h	1.00 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) :	

Objectives :
Team work, discovery of one's capabilities, communication, invention, autonomy, self-discovery and management responsibilities.

Content :
Whole class: "role of the coach, role of the referee, management" (knowledge of the rules, getting involved, leading, decision
making and communicating). Practice and knowledge of the sociomotive roles involved in the strategies of team attack and
team defence. Finding one's place in a group and awareness of your team-mates and their responsibilities.
Organisation of Physical and Sports Education: two 15-hour and one 30-hour sports or physical activity programmes in groups.

Bibliography :
Specialised publications are available at the library. Internet links are posted and updated on the INSA Physical Education website.

Requirements :

Organisation :

Evaluation :
Evaluation is based upon student participation, progress and acquisition. The student is asked to criticise his own progress with respect to the objectives of the course. The ability to be self-critical leads to self-discovery. Sharing this knowledge with a group reinforces one's confidence.

Target :

Semestre 9

Parcours Contrat de professionalisation

1	**INF09-1**		**Specialization**	**10.00**
	INF09-DevOps	O	Advanced Software Testing	3.50
	INF09-BDASW	O	Advanced Databases and Semantic Web	2.00
	INF09-DSL	O	Domain-Specific language	3.00
	INF09-CP	O	Competitive programming	1.50
2	**INF09-2**		**Projects and implementation**	**8.50**
	INF09-SFFS	O	From Know-How to let know	2.00
	INF09-HybLab	O	HybLab	2.00
	INF09-STGDATING	O	Internship Dating	0.50
	INF09-CCU	O	User-Centered System Design	4.00
3	**INF09-3**		**Opening course and options**	**6.00**
	INFT1-SPECIF	C	Formal Specification	2.00
	INFT1-IOT	C	Internet of Things	2.00
	INFT1-OPT	C	Optimization	2.00
	INF09-RV	C	Virtual Reality	2.00
	INF09-AMRG	C	Motion Analysis and Gesture Recognition (2D / 3D)	2.00
	INF09-SECU	C	Side channel attacks	2.00
	INF09-PROTOCOL	C	Protocols verification	2.00
	INF09-ALGODATA	C	Big Data Algorithms	2.00
	INF09-PRDATA	C	Big Data Project	2.00
	INF09-PRSLE	C	Project in large-scale systems	2.00
	INF09-AD	C	Distributed Algorithms	2.00
4	**HUM09-INFO-PRO**		**Non-scienti_c syllabus S9 (professional management)**	**5.50**
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50
	INF09-DROIT	O	Legal Training for Engineers	2.00
	HUM09-PM-PRO	O	Economics, Law and Business Studies (Professional management)	2.00

O = compulsary, C= in choice , F= optional

Advanced Software Testing	INF09-DevOps
Number of hours : 38.00 h	3.50 ECTS credit
CM : 10.00 h, EP : 16.00 h, TA : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
In industrial software developments the verification and validation activities cover between 35% and 55% of the production cost of software, maintenance and evolution excluded. Currently, test is a major technique for the verification and validation.
The goal of this lecture is to train students to the different software testing practices. Several fundamental principles are introduced (test goal, covering metric, specification). Different technique (unit, integration, and system testing) and development contexts (object-oriented, security, and model-based testing testing) will be detailed.

The concepts introduced are illustrated during practical works. These practical works mainly use Java and Eclipse (unit testing, mutation analysis, interaction testing, and GUI testing). The lectures are completed with industrial lectures introducing: test in the validation team of big companies ; a test lab ; a testing tool editor.

Content :
Lectures:
* Principles of software testing
* Object-oriented software testing
* Unit testing, mutation analysis, interaction testing, GUI testing
* Model-based testing

Practical works
Unit testing, mutation analysis, interaction testing, GUI testing with Eclipse and Java.
Technical project.

Bibliography :

Requirements :

Organisation :

Evaluation :
A project will be done on a software testing development subject. This project will be conducted during several practical sessions and will require personal work. This project will be presented and evaluated.

Target :

Advanced Databases and Semantic Web	INF09-BDASW
Number of hours : 43.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 14.00 h	handout in English
Reference Teacher(s) : CELLIER-BELLINA PEGGY	

Objectives :
This module has three main objectives: first, it provides an in-depth presentation of fundamental technical aspects of traditional Database Management Systems (DBMSs); second, it offers a study of the concepts of the NoSQL databases, and finally it introduces the semantic web concepts, in particular the representation of the linked data (RDF) and the query language (SPARQL).

Content :
1) In-depth presentation of fundamental aspects necessary for the practical management of relational DBMSs
- transactions. concurrency control. active DBMSs
- tuning

2) Presentation databases NoSQL
3) Introduction semantic web
- RDF, RDFS
- SPARQL
- OWL

Bibliography :
- Database Management Systems, R. Ramakrishnan et J. Gehrke, McGraw-Hill Higher Education, 2003
- XML, langage et applications, A. Michard, Eyrolles, 2000
- XML, des bases de données aux services Web, G. Gardarin, Dunod, 2002
- Le web sémantique, F. Gandon, C. Faron-Zucker, O. Corby, Dunod, 2012

Requirements :
Basics of relational DBMSs
Basic of XML and XQuery

Organisation :
- Hand-out in English and course possibly taught in English
- Need for deepening of the courses, and preparation of practical work.

Evaluation :
A two-hour written examination

Target :

Domain-Specific language	INF09-DSL
Number of hours : 34.00 h	3.00 ECTS credit
CM : 6.00 h, EP : 12.00 h, TA : 14.00 h	
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
Software industry faces the constant increase of systems complexity. Modelling aims at mastering this complexity through the Model-Driven Engineering (MDE) domain. In MDE, models focus on specific problems for a specific audience to ease the software development process. MDE tools help software engineers in developing and tooling languages that are designed to answer specific problems; we call such languages, domain-specific languages (DSL). MDE and DSLs are currently used by major companies (such as the French ones: Thales, EDF, Airbus).

The objective of this class is to understand the core concepts of MDE and the current major tools.
A focus is put on the creation of domain-specific languages through MDE approaches and tools.

keywords:
software engineering, domain-specific languages, generative programming, code generation, software modelling

Content :
Classes detail the core concepts and tools (Eclipse, Xtext, Sirius, Ecore).
Practical and project sessions aim at manipulating MDE tools to build domain-specific languages and their associated tools.

Bibliography :

Requirements :
A strong background in software engineering.
A background in software modelling (e.g. UML).

Organisation :

Evaluation :
The project is evaluated.

Target :

Competitive programming	INF09-CP
Number of hours : 20.00 h	1.50 ECTS credit
CM : 10.00 h, TP : 10.00 h	handout in English
Reference Teacher(s) : GARCIA PASCAL	

Objectives :
Learning to solve algorithmic problems.

Content :
- How to solve it?
- Design of algorithms by induction.
- Practical complexity.
- Data structures (heap, union-find, binary search tree, segment tree, ...).
- Specific design methods (brute-force, greedy, divide and conquer, dynamic programming, ...).
- Specific domains (graphs, string processing, ...).

Bibliography :
* Competitive Programming 3. Steven Alim and Felix Alim.
* Looking for a Challenge? The Ultimate Problem Set from the University of Warsaw Programming Competitions.
* The Hitchhiker's Guide to the Programming Contests.
* How to Solve It. G. Polya.
* Principles of Mathematical Problem Solving. Martin J. Erickson and Joe Flowers.
* The Art and Craft of Problem Solving. Paul Zeitz.
* Introduction to Algorithms: A Creative Approach. Udi Manber.

Requirements :

Organisation :
Cours/TD/TP

Evaluation :
Written exam

Target :

From Know-How to let know	INF09-SFFS
Number of hours : 30.00 h	2.00 ECTS credit
TD : 5.00 h	
Reference Teacher(s) : COUASNON BERTRAND	

Objectives :
This module has two objectives:
- The study of a technology not integrated in the courses of the Computer Science department: Know-How;
- The presentation of the expertise acquired to the other students: Let Know.

Content :
It comes in two ways depending on the choice of students:
1) Intervention in front of their colleagues
The students propose topics not covered in the curriculum they would like to know. In groups of 4 students, they study and
prepare a 3 hours technology session organized as they wish (eg in the form of lectures and practicals) for their colleagues.
Examples of topics: Ajax, Silverlight, Erlang, MDA, SAX, Ruby on Rails, Video Streaming, Cuda...
The study of the subject is in autonomy but a teacher supervises the preparation of the course and attends the presentation
during the session.
2) Collaboration with a company
A subject of study may be proposed by a company. In this case a group of students work in cooperation with the company and
prepare also a presentation of their work to their colleagues.

Bibliography :

Requirements :
None

Organisation :
Preparations of the course (the slot of the module is used only for presentations).

Evaluation :
Notation of the presented course.

Target :

HybLab	INF09-HybLab
Number of hours : 24.00 h	2.00 ECTS credit
EP : 24.00 h	
Reference Teacher(s) : LEPLUMEY IVAN	

Objectives :
Students must work in teamwork with students from other backgrounds (schools of journalism, communication, computer science and design) on concrete requests from media professionals such as TV channels, newspapers, Event Organizers ...

Content :
The HybLab is an innovative workshop devoted to datajournalism.
Project promoters (media, local authorities, start-ups ...) bring a set of data or content that they wish to exploit in an innovative way.
For several days, transdisciplinary teams of students will conduct this global project, from processing data or contents to prototyping and its online publication.
The event will be an opportunity to present projects and achievements in pitch form to convince a group of listeners. The final pitch will lead to the identification of the teams leading to the most compelling results.

Among the many subjects dealt with in previous sessions are:
- Explore and share your itineraries in Brittany (France 3 Bretagne)
- An interactive calendar to discover 25 years of Vieilles Charrues (les Vieilles Charrues)
- Enhanced podcasts to extend the learning experience (95.9 Radio Laser)
- Retrospective of the year 2016 (Ouest-France)
- 38 years of Transmusicales (Association Transmusicales)

Bibliography :
The previous edition is present on the site: http://www.hyblab.fr/hyblab-recits-interactifs-rennes-2016/
The work done during the 2 editions in which the computer science department of the INSA Rennes participated is searchable at : http://www.hyblab.fr/projets-hyblab/
There are many sites to find free tools to help create interactive and dynamic web pages:
Examples of websites: http://www.pearltrees.com/jkos/hyblab-archives-2-0/id13559536
Tools for timelines: http://www.experience-transmedia.com/outils-timeline/
Storymap tools: https://storymaps.arcgis.com

Requirements :
During this module, skills of Javascript type in web realization will be necessary.

Organisation :
Presentation of the projects on ½ day with formation of mixed groups, then 2 series of 2 days to work on the projects in group, followed by a final restitution.
Training through practice: Teamwork is based on concrete and innovative digital projects, from the creation process to the realization of models, through various choices and arbitrations.
Training in transdisciplinarity: the hybridization between professionals, researchers and students as well as between different skills or disciplines allows acculturation to other trades and languages.
Agility training: the user is at the center of an iterative and pragmatic process.

Evaluation :
Evaluation based on a grid of criteria related to the implication during the development of HybLab, pitch and final rendering.

Target :
Grade 5 students

Internship Dating	INF09-STGDATING
Number of hours : 15.00 h	0.50 ECTS credit
CONF : 15.00 h	
Reference Teacher(s) : COUASNON BERTRAND	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

User-Centered System Design	INF09-CCU
Number of hours : 49.33 h	4.00 ECTS credit
CM : 21.33 h, TP : 12.00 h	course taught in English
Reference Teacher(s) : DUCASSE MIREILLE	

Objectives :
User-centered system design involves users throughout the process of design. The users take part as experts of the use of the technology in its context, and as innovators while contributing ideas which allow to explore new ways of design.

This course is divided into two parts:

1- 20 hours of lectures carried out by ergonomists and designers coming from professional environments
2- an exercise of participative design which aims at collectively proposing improvements for an Internet site. That takes the form of a series of supervised practical exercises where particular techniques are implemented.

The main objective is to make the students aware that they will enormously gain to consult their potential users. A second objective is to grasp the contribution of concrete use-scenarios to understand the core of a system. A third objective is to analyze the situations of group work to know which technical types to use in which types of situations.

Content :
The approached techniques are:
* Role-play
* Interview of users, not computer specialists
* Specification of concrete and precise use-scenarios
* Brainstorming
* Prototyping
* Audit by people external to the project, users and pairs
* Birds of a Feather

Bibliography :
* Key principles for user-centred systems design. Jan Gulliksen, Bengt Göransson, Inger Boivie, Stefan Blomkvist, Jenny Persson et Åsa Cajander. Behaviour & Information Technology 22.6 (2003).
* Collaboration Engineering. Kolfschoten, Gwendolyn L., de Vreede, Gert-Jan, & Briggs, Robert O. 2010. In: Kilgour, D. Marc, & Eden, Colin, Kilgour, D. Marc, & Eden, Colin (eds), Handbook of Group Decision and Negotiation. Advances in Group Decision and Negotiation, vol. 4. Springer Netherlands (2010).
* Using Video to support interaction design. Wendy Mackay, INRIA, 2001.
* Conception participative. Lecture Hands-out (in French). M. Ducassé, INSA de Rennes, updated every year.

Requirements :
None

Organisation :
Organization

24h of lecture, 20h of supervised group work, 2 à 4h of stage preparation.

The interviews take place outside of supervised meetings. Each student is responsible for two interviews, s-he assists moreover students of her-his group to take notes at, at least, two other interviews.

The students work within a group. Concerning the participative design exercise, one student per group is responsible for the processing of each stage for this group. That responsibility is revolving. Each student is responsible on average for two stages, it attends the preparation of those stages and those which immediately precede them, in company of the other persons in charge and of the supervisor. These preparation meetings last 1 hour. During supervised stages, the supervisor moves from one group to another group and intervenes only when she considers it necessary.

Each supervised meeting ends with an analysis of its processes and students make a synthesis of what they learned. Which were the difficulties of implementation? When can one apply the technique of the day? In which

types of groups? What should it be paid attention at if one wants to use such a technique?

Evaluation :
* A report is collectively made to be sent to the persons in charge of the analyzed Internet site. Each group contributes to each chapter.
* Each student returns, moreover, a personal synthesis telling what s-he has learned attending this course and the points which could be improved.
* A collective presentation of group works is given at the end of the semester, if possible in front of at least one of the people responsible for the analyzed web site.

The note takes those three elements into account, with a large weight on the contribution to the collective report.

Target :

Formal Specification	INFT1-SPECIF
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : DUCASSE MIREILLE	

Objectives :
A terme, le génie logiciel pourra difficilement s'envisager sans méthode formelle. Les logiciels ayant de plus en plus de responsabilités (en vies humaines, économiques planétaires, etc), leur qualité ne pourra plus souffrir l'à peu près. Les méthodes formelles demandent des bases théoriques qui sont difficiles à acquérir en entreprise.

It is difficult to picture software engineering without the use of formal methods. Software applications are becoming increasingly involved in activities with large-scale responsibilities. They can for example impact human lives or the global economy. Software engineers must therefore be able to guaranty the quality of the produced softwares. Formal methods require theoretical bases, which are hard to acquire through work-experience alone; therefore, their introduction is considered a fundamental feature of the computer science curriculum.
This module is based on the B method developed by J.R. Abrial. It has numerous advantages. It is close to object-oriented programming. The theory behind it, although generous, is rather simple. It is based essentially on first-order logic and set theory. The B method has the advantage of being both state-of-the-art and already proven in practice for critical software development, as seen at RATP, the major transport operator for the Paris area.

This course focuses on the formal specification aspect of the B method. Indeed, this aspect requires abstraction work that is cognitively difficult and sparsely addressed in other modules, whereas aspects related to programming are close to methods addressed in many other courses.

At the end of the course, students are able to specify simple case studies and they can validate the correction of these specifications with respect to an invariant that specifies the contract to fulfil. They have acquired the foundation for further study of formal methods.

Content :
* Brief overview of the B method: Invariant, Abstract Machine, Refinement, Implementation, Proof Obligation
*Specification language: Generalized Substitutions, Sets, Functions and Relations,
* Case Studies

Bibliography :
* Assigning programs to meanings, the "B" Book, Jean-Raymond Abrial. Cambridge University Press, 1996.
* Introduction à la spécification, Henri Habrias. Masson éditeur, Collection "Méthodologies du Logiciel," 1993.
* Introduction to the B Method. Course hand-out (in English), Mireille Ducassé, INSA Rennes. (Updated every year and distributed to students.)

Requirements :
* Good knowledge of first order Logic and of proof mechanisms in that logic.

Organisation :
- Organisation: 14h of lecture and 12h of class work sessions (TD).
- Personal work: Revision of lecture notes. Preparation of lecture summary. Preparation of exercises for class work.

Evaluation :
* 9/10 of final grade: Two-hour written examination, at the end of the semester, without access to documentation except for the booklet collecting all the notations distributed at the beginning of the module.
* 1/10 of final grade: Lecture summaries, produced as homework and handed at the beginning of the next lecture.

Target :
Students wanting to investigate a rigorous and safe way of programming.

Internet of Things	INFT1-IOT
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, EP : 6.00 h, TA : 2.00 h, TP : 2.00 h	
Reference Teacher(s) :	

Objectives :
Introduction to the Internet of Things

Content :
(subject to change)

* Introduction to the Internet of Things
* Networks for IoT
* Operating Systems for IoT
* IoT and Big Data
* IoT, security and privacy
* IoT and healthcare
* IoT and home automation

Bibliography :

Requirements :
Basic knowledge in operating systems, networks and algorithms

Organisation :
Course, conferences and lab works in small groups for working with innovative devices

Evaluation :
Continuous review

Target :
5th year students

Optimization	INFT1-OPT
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 10.00 h, TP : 4.00 h	
Reference Teacher(s) :	

Objectives :
Overview of the problems and methods related to optimisation. Focus on continuous optimization. Introduction to Linear integer programming.

Content :
* Introduction and examples, Linear programming.
* Unconstrained optimisation: Optimality conditions. Gradient method. Nexton method.
* Constrained optimization: Optimality conditions. Feasible methods. Penalty methods.
* Introduction to Linear Integer programming.
* "Branch and bound" algorithms. Lagrangian relaxation methods.

Bibliography :
"Programmation mathématique" - M. MINOUX
"Méthodes d'optimisation combinatoire" - A. GERMA, O. HUDRY
"Optimisation numérique. Aspects théoriques et pratiques" - J.F. BONNANS, J.C. GILBERT, C. LEMARECHAL, C. SAGASTIZABAL

Requirements :
Basics of analysis and linear algebra.

Organisation :

Evaluation :
Two-hour examination at the end of the semester.

Target :

Virtual Reality	INF09-RV
Number of hours : 26.00 h	2.00 ECTS credit
TD : 26.00 h	
Reference Teacher(s) : ARNALDI BRUNO	

Objectives :
This module is designed to explore the fundamentals of virtual reality.
Introduction to all the technologies exploited in the general context of interactive applications.
Particular interested is paid to the following three points:
Principles of real-time visualisation.
Principles of movement generation.
Principles of interaction.

Content :
*Real-time visualisation.
*Geometric modelling by plane polygonal facets. Graphic pipeline. Geometric transformation. Filtering. Depth-buffer algorithm. Smoothing. Lighting treatment. Links with hardware. Large data bases.
*Movement generation.
Classification of models. Descriptive models. Movement interpolation. Procedural animation. Model generator. Physical model, movement control.
*Interaction.
*Virtual-reality devices. Hardware configurations. Interaction paradigms and metaphors. Constraints on the application.

Bibliography :
J.D. Foley, A. Van Dam, ""Fundamentals of Interactives Computer Graphics"" (sec. Ed), Addison-Wesley, 1982.
Le Traité de la Realité Virtuelle, 2ème édition, Edition des Presses de l'Ecole Nationale des Mines de Paris, Volume 1 et Volume 2, Gratuit en version électronique pour les étudiants http://www.caor.ensmp.fr/interlivre

Requirements :
None.

Organisation :
Revision of class notes. Research: Documents and methods.

Evaluation :
Two-hour written examination at the end of the semester. Mark for project.

Target :

Motion Analysis and Gesture Recognition (2D / 3D)	INF09-AMRG
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TP : 14.00 h	
Reference Teacher(s) : ANQUETIL ERIC	

Objectives :
Speakers : Eric Anquetil (Insa Rennes, Manager) -Richard Kulpa (Rennes 2 University) - Ludovic Hoyet (Inria)

With the development of touchscreen and motion capture technology, new human-computer interaction gains in popularity in the recent years. These approaches have been designed to take advantage of the interaction potential offered by 2D and 3D action gestures recognition. These gestural controls allow the user to execute many actions simply by doing Gestures. Recognition of human actions (2D and 3D action gestures) has recently become an active research topic in Computer Vision, Pattern Recognition and Man-Machine Interaction.
In this course, we address this emerging topic: Motion Analysis, Interpretation and Recognition of 2D and 3D Gestures for new Man-Machine Interactions. Technically, an action is a sequence generated by a human subject during the performance of a task. Action recognition deals with the process of labelling such motion sequence with respect to the depicted motions.
The course will expose the specificity of the recognition process of these two kinds of actions (2D and 3D action gestures) but also the potential convergence of the scientific approaches used for each of them. We will also discuss in this course the notions of animations, field of application for which the gestural commands can be fully exploited.

Content :
First part: Signal acquisition, Preprocessing and Normalization (Richard Kulpa)
* Pen-based and (Multi-)Touch Capture on touch screen: smartphone, tablet PC and tangible surface which support simultaneous participation of multiple users.
* Motion capture (MoCap) systems to extract body postures based on 3D joint positions and orientations by using markers and high precision camera array.
* Microsoft Kinect or Leap Motion sensor.
* Morphology-independent pre-processing
* Human skeleton modelling

Second part: Gesture Recognition (2D / 3D) (Eric Anquetil)
* 2D and 3D feature extraction
* Temporal, spatial, shape and motion relation modeling
* Segmented gesture recognition (Skeleton-based human action recognition)
* Recognition and Machine Learning Approaches:
o Graph modelling, DTW, HMM, SVM, NN…
o Reject Option…
* Unsegmented stream of gesture recognition.
o Temporal segmentation methods.
o Sliding Window approach.
* Man-Machine Interaction : Eager and lazy Recognition, Direct manipulation and indirect commands

Third part: Animation (Ludovic Hoyet)
* Direct and Inverse Kinematics (analytical and numerical methods)
* Interpolations (linear, splines, etc.)
* Motion Editing (motion warping, motion blending, transplanting, motion cleaning, etc.)
* Controlling Motions
o Finite State Machines
o Motions Graphs

Bibliography :
[1] A. Delaye and E. Anquetil, “Hbf49 feature set: A first unified baseline for online symbol recognition,” Pattern Recognition, vol. 46, no. 1, pp. 117–130, 2013.
[2] Z. Chen, E. Anquetil, H. Mouchère, and C. Viard-Gaudin, “Recognize multi-touch gestures by graph modeling and matching,” in 17th Biennial Conference of the International Graphonomics Society, Pointe-a`-Pitre, France, Jun. 2015.
[3] D. Rubine, “Specifying gestures by example,” in Proceedings of the 18th Annual Conference on Computer Graphics and Interactive Techniques, ser. SIGGRAPH ’91. New York, NY, USA: ACM, 1991, pp. 329–337.
[4] S. Macé and E. Anquetil, “Eager interpretation of on-line hand-drawn structured documents: The dali methodology,” Pattern Recognition, vol. 42, no. 12, pp. 3202–3214, Dec. 2009.

[5] M. Mu¨ller, T. Ro¨der, M. Clausen, B. Eberhardt, B. Kru¨ger, and Weber, “Documentation mocap database hdm05,” 2007.
[6] Said Yacine Boulahia, Eric Anquetil, Richard Kulpa, Franck Multon, HIF3D: Handwriting-Inspired Features for 3D Skeleton-Based Action Recognition, IEEE. 23rd International Conference on Pattern Recognition (ICPR 2016), Dec 2016, Cancun, Mexico.
[7] Zhaoxin Chen, Eric Anquetil, Harold Mouchère, Christian Viard-Gaudin, The MUMTDB dataset for evaluating simultaneous composition of structured documents in a multi-user and multi-touch environment, 15th International Conference on Frontiers in Handwriting Recognition, Oct 2016, Shenzhen, China
[8] L. Xia, C.-C. Chen, and J. Aggarwal, “View invariant human action recognition using histograms of 3d joints,” in IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp. 20–27, 2012.
[9] M. A. Gowayyed, M. Torki, M. E. Hussein, and M. El-Saban, “Histogram of oriented displacements (hod): describing trajectories of human joints for action recognition,” in Proceedings of the International Joint Conference on Artificial Intelligence, pp. 1351–1357, 2013.
[10] R. Vemulapalli, F. Arrate, and R. Chellappa, “Human action recog- nition by representing 3d skeletons as points in a lie group,” in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 588–595, 2014.
[11] R. Chaudhry, F. Ofli, G. Kurillo, R. Bajcsy, and R. Vidal, “Bio- inspired dynamic 3d discriminative skeletal features for human action recognition,” in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, pp. 471–478,2013.
[12] H. Zhang and L. E. Parker, “Bio-inspired predictive orientation decomposition of skeleton trajectories for real-time human activity prediction,” in Proceedings of the IEEE International Conference on Robotics and Automation, pp. 3053–3060, 2015.
[13] R. Kulpa, F. Multon, and B. Arnaldi, “Morphology-independent representation of motions for interactive human-like animation,” in Computer Graphics Forum, vol. 24, pp. 343–351, 2005.
[14] A. Sorel, R. Kulpa, E. Badier, and F. Multon, “Dealing with vari- ability when recognizing user’s performance in natural 3d gesture interfaces,” International Journal of Pattern Recognition and Artificial Intelligence, vol. 27, no. 08, 2013.
[15] M. E. Hussein, M. Torki, M. A. Gowayyed, and M. El-Saban, “Human action recognition using a temporal hierarchy of covariance descriptors on 3d joint locations,” in Proceedings of the International Joint Conference on Artificial Intelligence, vol. 13, pp. 2466–2472, 2013.
[16] G. Evangelidis, G. Singh, and R. Horaud, “Skeletal quads: Human action recognition using joint quadruples,” in Proceedings of the IEEE International Conference on Pattern Recognition, pp. 4513– 4518, 2014.
[17] V. Bloom, D. Makris, and V. Argyriou. Clustered spatio- temporal manifolds for online action recognition. In Pattern Recognition (ICPR), 2014 22nd International Conference on, pages 3963–3968. IEEE, 2014.
[18] Y. Li, C. Lan, J. Xing, W. Zeng, C. Yuan, and J. Liu. Online human action detection using joint classification-regression recurrent neural networks. arXiv preprint arXiv:1604.05633, 2016.
[19] finger-count interaction: Combining multitouch gestures and menus”, International Journal of Human-Computer Studies, v.70 n.10, p.673-689, October, 2012.
[20] Sriganesh Madhvanath, Dinesh Mandalapu, Tarun Madan, Naznin Rao, Ramesh Kozhissery, “GeCCo: Finger gesture-based command and control for touch interfaces”, IHCI 2012: 1-6.
[21] Armin Bruderlin and Lance Williams. 1995. Motion signal processing. In Proceedings of the 22nd annual conference on Computer graphics and interactive techniques (SIGGRAPH '95), Susan G. Mair and Robert Cook (Eds.). ACM, New York, NY, USA, 97-104.
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[27] Lucas Kovar, John Schreiner, and Michael Gleicher. 2002. Footskate cleanup for motion capture editing. In Proceedings of the 2002 ACM SIGGRAPH/Eurographics symposium on Computer animation (SCA '02). ACM, New York, NY, USA, 97-104.

Requirements :
Object-oriented programming

Organisation :
This module will be articulated on a course (16h) which will be supported by a TP (10h), applying the notions of the course through a practical realization dealing with the capture of the gesture, its recognition and its use in the context of an animation challenge.

Evaluation :
The evaluation is based on a defense of the TP / project developed during the module. The presentation support and the developed code will be part of the requested deliverables.

Target :

Side channel attacks	INF09-SECU
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : AVOINE GILDAS	

Objectives :
Learn the fundamentals of hardware-based and software-based side channel attacks and their countermeasures.

Content :
The course on “Side-channel attacks” addresses the specificities of software and hardware systems that lead to side-channel attacks. To keep in touch with real-life concerns as well as state-of-the art research, the course is taught by an engineer-researcher from the French ministry of defense (DGA-MI) whose activities are related to embedded cryptography, and a full-time CNRS researcher whose research is related to micro-architectural attacks.

The course considers techniques for secure implementations, physical attacks on microcircuits (timing and power side-channel attacks, fault injection attacks, etc.), as well as software-based attacks on micro-architecture of modern CPUs (side-channel attacks on caches and fault attacks on DRAM, etc.).

Bibliography :

Requirements :
The courses “engineering cryptography” and “operating system” from INSA Rennes (4INFO), or any other equivalent courses.

Organisation :
A large part of the course is devoted to hands-on sessions.

Evaluation :
Theoretical examination in a computer room, with an additional (randomly chosen) lab presentation.

Target :
5 INFO

Protocols verification	INF09-PROTOCOL
Number of hours : 26.00 h	2.00 ECTS credit
CM : 20.00 h, EP : 6.00 h	
Reference Teacher(s) : FILA BARBARA	

Objectives :
The objective of this course is to provide students with an in-depth knowledge regarding methods and tools for the specification, design, and symbolic verification of security protocols in various domains.

After a successful completion of this course, the students should be able to:
- Specify a protocol in a suitable formal framework;
- Formally define the security property against which the protocol should be checked;
- Select an appropriate verification tool to analyze the protocol;
- Detect logical flaws in improperly designed or implemented protocols.

Content :
The following topics will be covered in this course:
* Formal ways of specifying a protocol: Alice & Bob notation, message sequence charts, process algebra, Horn clauses, constraint systems, applied pi calculus;
* Attacker models: passive and active attackers, Dolev-Yao adversary, knowledge inference;
* Formal specification of security properties: trace properties, indistinguishability properties, equivalence properties, weak and strong secrecy, authentication (aliveness, agreement, synchronization), anonymity;
* Man-in-the-middle attacks;
* Protocol verification with a bounded number of sessions: constraint systems;
* Protocol verification with an unbounded number of sessions: Horn Clauses;
* Tools for automatic verification of security protocols: get started with Scyther, go deeper with ProVerif.

Bibliography :
- Cas Cremers and Sjouke Mauw. Operational Semantics and Verification of Security Protocols, Springer 2012, ISBN: 978-3-540-78635-1 (Print) 978-3-540-78636-8 (Online).
- Véronique Cortier, Steve Kremer. Formal Models and Techniques for Analyzing Security Protocols: A Tutorial. Foundations and Trends in Programming Languages 1(3): 151-267 (2014).

Requirements :
Introduction to security course 3INFO

Organisation :
Studying course work; personal work on the project.
This course will partially be taught in English.

Evaluation :
- Two-hour written examination (2/3 of teh final grade)
- Project (1/3 of teh final grade)

Target :
5info - Security track

Big Data Algorithms	INF09-ALGODATA
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 8.00 h, TP : 4.00 h	
Reference Teacher(s) : COSTAN ALEXANDRU	

Objectives :
The goal of this course is tu study how to analyze, organize and present Big Data in order to address their specific challenges: reduce the complexity, process the data deluge in real time, propose new paradigms to allow the extraction of relevant knowledge. The course focuses on the main design principles of the fundamental algorithms for Big Data processing. In particular, we will study algorithms for stream processing, social networks, recommandation systems, classification, trend detection and sentiment analysis.

Content :
- Graph theory and social networks
- Sentiment analysis and trend detection
- Stream processing
- Classification algorithms
- Recommandation algorithms
- Fake news detection
- Clustering algorithms

Bibliography :
B. Howe, Introduction to Data Science
R. Swan, J. Allan, Automatic Generation of Overview Timelines
H.R. Varian, H. Choi, Predic;ng the Present with Google Trends, Google Research Blog
J. Allan, R. Papka, V. Lavrenko, On-line New Event Detection and Tracking
R. Bandari, S. Asur, B. Huberman, The Pulse of News in Social Media: Forecasting Popularity

Requirements :
Database and systems (cloud, parallelism) concepts, Java programming skills. Knowledge of Apache Hadoop and Apache Spark.

Organisation :
Lectures and practical labs.

Evaluation :
Grading of practical labs.

Target :
Students interested in becoming data scientists, big data analysts, social networks experts.

Big Data Project	INF09-PRDATA
Number of hours : 26.00 h	2.00 ECTS credit
EP : 26.00 h	
Reference Teacher(s) : COSTAN ALEXANDRU	

Objectives :
The goal of the project is to support with a hands-on experience the challenges seen in the Big Data courses, with a particular focus on social networks, mobiles and analytics challenges. The objective is to master the know-how needed to addresses various real-life use-cases.

Content :
- Social networks applications
- Bioinformatics applications
- Big Data analytics

Bibliography :
Apache Spark
Apache Flink
Apache Beam

Requirements :
Database and systems (cloud, parallelism) concepts, Java programming skills. Knowledge of Apache Hadoop and Apache Spark.

Organisation :
Project sessions.

Evaluation :
Evaluation of the project defence.

Target :
Students interested in becoming data scientists, big data analysts, social networks experts.

Project in large-scale systems	INF09-PRSLE
Number of hours : 26.00 h	2.00 ECTS credit
CM : 2.00 h, EP : 24.00 h	
Reference Teacher(s) : PARLAVANTZAS NIKOLAOS	

Objectives :
This project involves realising and evaluating a large-scale system using modern technologies, such as cloud computing and multicore architectures. The objective is to allow students to deepen their knowledge of the techniques seen in the modules of the Large-Scale Systems option.

Content :
- Cloud infrastructures
- Scientific computing
- Internet of Things

Bibliography :

Requirements :
Knowledge in cloud computing, parallelism, and networks

Organisation :
Project sessions

Evaluation :
Project defence

Target :
Students interested in careers as research and DevOps engineers

Distributed Algorithms	INF09-AD
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 4.00 h, TP : 8.00 h	
Reference Teacher(s) : BERTIER MARIN	

Objectives :
* This module presents the basic concepts of parallelism and distributed computing for programming and algorithms to
complement the presentation of the low-level mechanisms seen in the fourth year "systems" module.
* Basic concepts are studied and illustrated through examples of parallel languages like Java as well as through the use of middleware and widely used libraries of communication (Java RMI, CORBA, MPI).
* The concepts and problems associated with algorithms and synchronisation are tackled.

Content :
PARALLELISM
* Execution parallelism and parallel machine. Parallelism of expression.
COMMUNICATING PROCESS BY VARIABLE SHARING
* Java threads.
* Java semaphore. Synchronisation monitors and synchronous methods.
* Software engineering and parallelism in Java.
DISTRIBUTED PROCESS
* Remote Procedure Call: Customer-server model. N-tier.
* RMI Java programming. CORBA remote method call.
* Communicating process by message exchanges: MPI
DISTRIBUTED ALGORITHMS
* Time.
* Global state.
* Election. Consensus.
PEER-TO-PEER MODEL: JXTA.
CONCLUSION.

Bibliography :
La programmation parallèle : outils, méthodes et éléments de mise en oeuvre.J.-P. Banâtre. Eyrolles, 1991.
Algorithmes et architectures parallèles Michel Cosnard, Denis Trystram. InterEditions 1993.
Concurrent Programming in Java: Design
Principles and Patterns, Doug Lea, 2e édition Addison-Wesley, 1999.

Requirements :
Experience with C and Java languages.
Good knowledge of operating systems (process, threads, semaphores).

Organisation :
Revision of lecture notes. Preparation of practical work. Further research on the student's own initiative.

Evaluation :
Two-hour written examination.

Target :

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in a professional or social context.
- Obtaining or reinforcing C1 level, strongly advised/recommended by the CTI. t.

Content :
- Learning by doing: students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
- Expressing oneself accurately and fluently: students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
1. English Grammar in Use (Cambridge University Press)
2. Dictionnaire Collins Cobuild
3. Polycopié de l' INSA

Requirements :
Having taken and passed the TOEIC test during the previous two years (800 required)
or any other B2 certification recognized by the CTI.

Organisation :
- Each class lasts one hour and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
- Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet.

Evaluation :
Continuous assessment: The final mark (out of 20) will be based on the attendance rate and the personal implication of the student during the class.

Target :

TOEIC 5th year	HUM09-ANGL-TOEIC
Number of hours : 20.00 h	1.50 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in company and business context.
- Obtaining or reinforcing the B2 level requested by the CTI.
- Obtaining 800 score at the final TOEIC test.

Content :
Learning by doing : students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
Expressing oneself accurately and fluently : students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
- English grammar in Use, Intermediate Edition (CUP)
- Robert and Collins bilingual dictionary or Collins Cobuild

Requirements :
Not having already taken and passed the TOEIC test during the previous two years
B1/B2 level advised

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet. B2 level tests are also taken throughout the course.

Evaluation :
Final mark based on :
TOEIC score at final exam + attendance (more than 4 non justified absences result in 0/20 mark).

Target :
5th year students who haven't already passed their TOEIC

Legal Training for Engineers	INF09-DROIT
Number of hours : 20.00 h	2.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) :	

Objectives :
To give to final-year engineers, whether or not in project manager positions, the key legal concepts for understanding the protection of intellectual creations and software, the contractual mechanisms for producing software content, and the terms of software licenses.

Content :
5 independent modules CM1 to CM5

CM1: COMPUTER CREATIONS AND ACTORS

CM 2: GENERIC CONTRACTUAL STRUCTURES AND RESPONSIBILITIES

CM 3: SPECIFIC CONTRACTUAL STRUCTURES

CM 4: SOFTWARE LICENSES (INCLUDING GPL)

CM 5: CREATION AND ADMINISTRATION OF WEB SITES

Bibliography :
On the internet : http://www.legalis.net/

Books : Informatique, T_l_coms, Internet - Ed Francis Lefebvre 2012

Requirements :
passing the introductory module to general law (8H Lectures)

Organisation :
Lectures (7 x 2H)

Evaluation :
final exam

Target :

Economics, Law and Business Studies (Professional management)	HUM09-PM-PRO
Number of hours : 70.00 h	2.00 ECTS credit
TA : 70.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Semestre 9

Parcours Formation Initiale INFO

1	**INF09-1**		**Specialization**	**10.00**
	INF09-DevOps	O	Advanced Software Testing	3.50
	INF09-BDASW	O	Advanced Databases and Semantic Web	2.00
	INF09-DSL	O	Domain-Specific language	3.00
	INF09-CP	O	Competitive programming	1.50
2	**INF09-2**		**Projects and implementation**	**8.50**
	INF09-SFFS	O	From Know-How to let know	2.00
	INF09-HybLab	O	HybLab	2.00
	INF09-STGDATING	O	Internship Dating	0.50
	INF09-CCU	O	User-Centered System Design	4.00
3	**INF09-3**		**Opening course and options**	**6.00**
	INFT1-SPECIF	C	Formal Specification	2.00
	INFT1-IOT	C	Internet of Things	2.00
	INFT1-OPT	C	Optimization	2.00
	INF09-RV	C	Virtual Reality	2.00
	INF09-AMRG	C	Motion Analysis and Gesture Recognition (2D / 3D)	2.00
	INF09-SECU	C	Side channel attacks	2.00
	INF09-PROTOCOL	C	Protocols verification	2.00
	INF09-ALGODATA	C	Big Data Algorithms	2.00
	INF09-PRDATA	C	Big Data Project	2.00
	INF09-PRSLE	C	Project in large-scale systems	2.00
	INF09-AD	C	Distributed Algorithms	2.00
4	**HUM09**		**Non-scientific syllabus S9**	**5.50**
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50
	HUM09-PM-A	C	Economics, Law and Business Studies A (Lean six sigma)	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resource Management)	2.00
	HUM09-PM-C	C	Economics, Law and Business Studies C (Human Resources Management)	2.00
	HUM09-PM-D	C	Economics, Law and Business Studies D (MANAGEMENT - ETHICS - RESPONSIBILITY)	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (International Strategy and Development)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Evaluation stage	1.00
	HUM09-PM-G	C	Economics, Law and Business Studies G (serious game)	2.00
	EII09-HUMT	C	Societal responsibility of business	1.00
	EII09-EVST	C	Evaluation stage	1.00
	INF09-DROIT	C	Legal Training for Engineers	2.00
	SRC09-SPEC	C	Conferences	1.00
	SRC09-CONF	C	SRC09-CONFERENCES	1.00

O = compulsary, C= in choice , F= optional

Advanced Software Testing	INF09-DevOps
Number of hours : 38.00 h	3.50 ECTS credit
CM : 10.00 h, EP : 16.00 h, TA : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
In industrial software developments the verification and validation activities cover between 35% and 55% of the production cost of software, maintenance and evolution excluded. Currently, test is a major technique for the verification and validation.
The goal of this lecture is to train students to the different software testing practices. Several fundamental principles are introduced (test goal, covering metric, specification). Different technique (unit, integration, and system testing) and development contexts (object-oriented, security, and model-based testing testing) will be detailed.

The concepts introduced are illustrated during practical works. These practical works mainly use Java and Eclipse (unit testing, mutation analysis, interaction testing, and GUI testing). The lectures are completed with industrial lectures introducing: test in the validation team of big companies ; a test lab ; a testing tool editor.

Content :
Lectures:
* Principles of software testing
* Object-oriented software testing
* Unit testing, mutation analysis, interaction testing, GUI testing
* Model-based testing

Practical works
Unit testing, mutation analysis, interaction testing, GUI testing with Eclipse and Java.
Technical project.

Bibliography :

Requirements :

Organisation :

Evaluation :
A project will be done on a software testing development subject. This project will be conducted during several practical sessions and will require personal work. This project will be presented and evaluated.

Target :

Advanced Databases and Semantic Web	INF09-BDASW
Number of hours : 43.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 14.00 h	handout in English
Reference Teacher(s) : CELLIER-BELLINA PEGGY	

Objectives :
This module has three main objectives: first, it provides an in-depth presentation of fundamental technical aspects of traditional Database Management Systems (DBMSs); second, it offers a study of the concepts of the NoSQL databases, and finally it introduces the semantic web concepts, in particular the representation of the linked data (RDF) and the query language (SPARQL).

Content :
1) In-depth presentation of fundamental aspects necessary for the practical management of relational DBMSs
- transactions. concurrency control. active DBMSs
- tuning

2) Presentation databases NoSQL
3) Introduction semantic web
- RDF, RDFS
- SPARQL
- OWL

Bibliography :
- Database Management Systems, R. Ramakrishnan et J. Gehrke, McGraw-Hill Higher Education, 2003
- XML, langage et applications, A. Michard, Eyrolles, 2000
- XML, des bases de données aux services Web, G. Gardarin, Dunod, 2002
- Le web sémantique, F. Gandon, C. Faron-Zucker, O. Corby, Dunod, 2012

Requirements :
Basics of relational DBMSs
Basic of XML and XQuery

Organisation :
- Hand-out in English and course possibly taught in English
- Need for deepening of the courses, and preparation of practical work.

Evaluation :
A two-hour written examination

Target :

Domain-Specific language	INF09-DSL
Number of hours : 34.00 h	3.00 ECTS credit
CM : 6.00 h, EP : 12.00 h, TA : 14.00 h	
Reference Teacher(s) : BLOUIN ARNAUD	

Objectives :
Software industry faces the constant increase of systems complexity. Modelling aims at mastering this complexity through the Model-Driven Engineering (MDE) domain. In MDE, models focus on specific problems for a specific audience to ease the software development process. MDE tools help software engineers in developing and tooling languages that are designed to answer specific problems; we call such languages, domain-specific languages (DSL). MDE and DSLs are currently used by major companies (such as the French ones: Thales, EDF, Airbus).

The objective of this class is to understand the core concepts of MDE and the current major tools.
A focus is put on the creation of domain-specific languages through MDE approaches and tools.

keywords:
software engineering, domain-specific languages, generative programming, code generation, software modelling

Content :
Classes detail the core concepts and tools (Eclipse, Xtext, Sirius, Ecore).
Practical and project sessions aim at manipulating MDE tools to build domain-specific languages and their associated tools.

Bibliography :

Requirements :
A strong background in software engineering.
A background in software modelling (e.g. UML).

Organisation :

Evaluation :
The project is evaluated.

Target :

Competitive programming	INF09-CP
Number of hours : 20.00 h	1.50 ECTS credit
CM : 10.00 h, TP : 10.00 h	handout in English
Reference Teacher(s) : GARCIA PASCAL	

Objectives :
Learning to solve algorithmic problems.

Content :
- How to solve it?
- Design of algorithms by induction.
- Practical complexity.
- Data structures (heap, union-find, binary search tree, segment tree, ...).
- Specific design methods (brute-force, greedy, divide and conquer, dynamic programming, ...).
- Specific domains (graphs, string processing, ...).

Bibliography :
* Competitive Programming 3. Steven Alim and Felix Alim.
* Looking for a Challenge? The Ultimate Problem Set from the University of Warsaw Programming Competitions.
* The Hitchhiker's Guide to the Programming Contests.
* How to Solve It. G. Polya.
* Principles of Mathematical Problem Solving. Martin J. Erickson and Joe Flowers.
* The Art and Craft of Problem Solving. Paul Zeitz.
* Introduction to Algorithms: A Creative Approach. Udi Manber.

Requirements :

Organisation :
Cours/TD/TP

Evaluation :
Written exam

Target :

From Know-How to let know	INF09-SFFS
Number of hours : 30.00 h	2.00 ECTS credit
TD : 5.00 h	
Reference Teacher(s) : COUASNON BERTRAND	

Objectives :
This module has two objectives:
- The study of a technology not integrated in the courses of the Computer Science department: Know-How;
- The presentation of the expertise acquired to the other students: Let Know.

Content :
It comes in two ways depending on the choice of students:
1) Intervention in front of their colleagues
The students propose topics not covered in the curriculum they would like to know. In groups of 4 students, they study and
prepare a 3 hours technology session organized as they wish (eg in the form of lectures and practicals) for their colleagues.
Examples of topics: Ajax, Silverlight, Erlang, MDA, SAX, Ruby on Rails, Video Streaming, Cuda...
The study of the subject is in autonomy but a teacher supervises the preparation of the course and attends the presentation
during the session.
2) Collaboration with a company
A subject of study may be proposed by a company. In this case a group of students work in cooperation with the company and
prepare also a presentation of their work to their colleagues.

Bibliography :

Requirements :
None

Organisation :
Preparations of the course (the slot of the module is used only for presentations).

Evaluation :
Notation of the presented course.

Target :

HybLab	INF09-HybLab
Number of hours : 24.00 h	2.00 ECTS credit
EP : 24.00 h	
Reference Teacher(s) : LEPLUMEY IVAN	

Objectives :
Students must work in teamwork with students from other backgrounds (schools of journalism, communication, computer science and design) on concrete requests from media professionals such as TV channels, newspapers, Event Organizers ...

Content :
The HybLab is an innovative workshop devoted to datajournalism.
Project promoters (media, local authorities, start-ups ...) bring a set of data or content that they wish to exploit in an innovative way.
For several days, transdisciplinary teams of students will conduct this global project, from processing data or contents to prototyping and its online publication.
The event will be an opportunity to present projects and achievements in pitch form to convince a group of listeners. The final pitch will lead to the identification of the teams leading to the most compelling results.

Among the many subjects dealt with in previous sessions are:
- Explore and share your itineraries in Brittany (France 3 Bretagne)
- An interactive calendar to discover 25 years of Vieilles Charrues (les Vieilles Charrues)
- Enhanced podcasts to extend the learning experience (95.9 Radio Laser)
- Retrospective of the year 2016 (Ouest-France)
- 38 years of Transmusicales (Association Transmusicales)

Bibliography :
The previous edition is present on the site: http://www.hyblab.fr/hyblab-recits-interactifs-rennes-2016/
The work done during the 2 editions in which the computer science department of the INSA Rennes participated is searchable at : http://www.hyblab.fr/projets-hyblab/
There are many sites to find free tools to help create interactive and dynamic web pages:
Examples of websites: http://www.pearltrees.com/jkos/hyblab-archives-2-0/id13559536
Tools for timelines: http://www.experience-transmedia.com/outils-timeline/
Storymap tools: https://storymaps.arcgis.com

Requirements :
During this module, skills of Javascript type in web realization will be necessary.

Organisation :
Presentation of the projects on ½ day with formation of mixed groups, then 2 series of 2 days to work on the projects in group, followed by a final restitution.
Training through practice: Teamwork is based on concrete and innovative digital projects, from the creation process to the realization of models, through various choices and arbitrations.
Training in transdisciplinarity: the hybridization between professionals, researchers and students as well as between different skills or disciplines allows acculturation to other trades and languages.
Agility training: the user is at the center of an iterative and pragmatic process.

Evaluation :
Evaluation based on a grid of criteria related to the implication during the development of HybLab, pitch and final rendering.

Target :
Grade 5 students

Internship Dating	INF09-STGDATING
Number of hours : 15.00 h	0.50 ECTS credit
CONF : 15.00 h	
Reference Teacher(s) : COUASNON BERTRAND	

Objectives :
The purpose of this module is to complete the curriculum by knowledge, practices, industrial problems not seen in other modules. It gives students a better knowledge of business world, its internal and external ecosystem, professions. It is also a way to build links between students and companies.

Content :
The "stage dating" allows students to have several short interviews of 10mn with different companies.

Conferences are done by industrial contributors, on different subjects like:
- data management, data science, big data
- introduction to the profession of IT architect

Conferences can be 2 hours long, several modules of 2 hours or organized on a whole day.

Bibliography :

Requirements :

Organisation :
A group of student volunteers, with the teacher in charge of the module, define and organize the different conferences.

Evaluation :
Validation on the presence of the student

Target :

User-Centered System Design	INF09-CCU
Number of hours : 49.33 h	4.00 ECTS credit
CM : 21.33 h, TP : 12.00 h	course taught in English
Reference Teacher(s) : DUCASSE MIREILLE	

Objectives :
User-centered system design involves users throughout the process of design. The users take part as experts of the use of the technology in its context, and as innovators while contributing ideas which allow to explore new ways of design.

This course is divided into two parts:

1- 20 hours of lectures carried out by ergonomists and designers coming from professional environments
2- an exercise of participative design which aims at collectively proposing improvements for an Internet site. That takes the form of a series of supervised practical exercises where particular techniques are implemented.

The main objective is to make the students aware that they will enormously gain to consult their potential users. A second objective is to grasp the contribution of concrete use-scenarios to understand the core of a system. A third objective is to analyze the situations of group work to know which technical types to use in which types of situations.

Content :
The approached techniques are:
* Role-play
* Interview of users, not computer specialists
* Specification of concrete and precise use-scenarios
* Brainstorming
* Prototyping
* Audit by people external to the project, users and pairs
* Birds of a Feather

Bibliography :
* Key principles for user-centred systems design. Jan Gulliksen, Bengt Göransson, Inger Boivie, Stefan Blomkvist, Jenny Persson et Åsa Cajander. Behaviour & Information Technology 22.6 (2003).
* Collaboration Engineering. Kolfschoten, Gwendolyn L., de Vreede, Gert-Jan, & Briggs, Robert O. 2010. In: Kilgour, D. Marc, & Eden, Colin, Kilgour, D. Marc, & Eden, Colin (eds), Handbook of Group Decision and Negotiation. Advances in Group Decision and Negotiation, vol. 4. Springer Netherlands (2010).
* Using Video to support interaction design. Wendy Mackay, INRIA, 2001.
* Conception participative. Lecture Hands-out (in French). M. Ducassé, INSA de Rennes, updated every year.

Requirements :
None

Organisation :
Organization

24h of lecture, 20h of supervised group work, 2 à 4h of stage preparation.

The interviews take place outside of supervised meetings. Each student is responsible for two interviews, s-he assists moreover students of her-his group to take notes at, at least, two other interviews.

The students work within a group. Concerning the participative design exercise, one student per group is responsible for the processing of each stage for this group. That responsibility is revolving. Each student is responsible on average for two stages, it attends the preparation of those stages and those which immediately precede them, in company of the other persons in charge and of the supervisor. These preparation meetings last 1 hour. During supervised stages, the supervisor moves from one group to another group and intervenes only when she considers it necessary.

Each supervised meeting ends with an analysis of its processes and students make a synthesis of what they learned. Which were the difficulties of implementation? When can one apply the technique of the day? In which

types of groups? What should it be paid attention at if one wants to use such a technique?

Evaluation :
* A report is collectively made to be sent to the persons in charge of the analyzed Internet site. Each group contributes to each chapter.
* Each student returns, moreover, a personal synthesis telling what s-he has learned attending this course and the points which could be improved.
* A collective presentation of group works is given at the end of the semester, if possible in front of at least one of the people responsible for the analyzed web site.

The note takes those three elements into account, with a large weight on the contribution to the collective report.

Target :

Formal Specification	INFT1-SPECIF
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : DUCASSE MIREILLE	

Objectives :
A terme, le génie logiciel pourra difficilement s'envisager sans méthode formelle. Les logiciels ayant de plus en plus de responsabilités (en vies humaines, économiques planétaires, etc), leur qualité ne pourra plus souffrir l'à peu près. Les méthodes formelles demandent des bases théoriques qui sont difficiles à acquérir en entreprise.

It is difficult to picture software engineering without the use of formal methods. Software applications are becoming increasingly involved in activities with large-scale responsibilities. They can for example impact human lives or the global economy. Software engineers must therefore be able to guaranty the quality of the produced softwares. Formal methods require theoretical bases, which are hard to acquire through work-experience alone; therefore, their introduction is considered a fundamental feature of the computer science curriculum.
This module is based on the B method developed by J.R. Abrial. It has numerous advantages. It is close to object-oriented programming. The theory behind it, although generous, is rather simple. It is based essentially on first-order logic and set theory. The B method has the advantage of being both state-of-the-art and already proven in practice for critical software development, as seen at RATP, the major transport operator for the Paris area.

This course focuses on the formal specification aspect of the B method. Indeed, this aspect requires abstraction work that is cognitively difficult and sparsely addressed in other modules, whereas aspects related to programming are close to methods addressed in many other courses.

At the end of the course, students are able to specify simple case studies and they can validate the correction of these specifications with respect to an invariant that specifies the contract to fulfil. They have acquired the foundation for further study of formal methods.

Content :
* Brief overview of the B method: Invariant, Abstract Machine, Refinement, Implementation, Proof Obligation
*Specification language: Generalized Substitutions, Sets, Functions and Relations,
* Case Studies

Bibliography :
* Assigning programs to meanings, the "B" Book, Jean-Raymond Abrial. Cambridge University Press, 1996.
* Introduction à la spécification, Henri Habrias. Masson éditeur, Collection "Méthodologies du Logiciel," 1993.
* Introduction to the B Method. Course hand-out (in English), Mireille Ducassé, INSA Rennes. (Updated every year and distributed to students.)

Requirements :
* Good knowledge of first order Logic and of proof mechanisms in that logic.

Organisation :
- Organisation: 14h of lecture and 12h of class work sessions (TD).
- Personal work: Revision of lecture notes. Preparation of lecture summary. Preparation of exercises for class work.

Evaluation :
* 9/10 of final grade: Two-hour written examination, at the end of the semester, without access to documentation except for the booklet collecting all the notations distributed at the beginning of the module.
* 1/10 of final grade: Lecture summaries, produced as homework and handed at the beginning of the next lecture.

Target :
Students wanting to investigate a rigorous and safe way of programming.

Internet of Things	INFT1-IOT
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, EP : 6.00 h, TA : 2.00 h, TP : 2.00 h	
Reference Teacher(s) :	

Objectives :
Introduction to the Internet of Things

Content :
(subject to change)

* Introduction to the Internet of Things
* Networks for IoT
* Operating Systems for IoT
* IoT and Big Data
* IoT, security and privacy
* IoT and healthcare
* IoT and home automation

Bibliography :

Requirements :
Basic knowledge in operating systems, networks and algorithms

Organisation :
Course, conferences and lab works in small groups for working with innovative devices

Evaluation :
Continuous review

Target :
5th year students

Optimization	INFT1-OPT
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TD : 10.00 h, TP : 4.00 h	
Reference Teacher(s) :	

Objectives :
Overview of the problems and methods related to optimisation. Focus on continuous optimization. Introduction to Linear integer programming.

Content :
* Introduction and examples, Linear programming.
* Unconstrained optimisation: Optimality conditions. Gradient method. Nexton method.
* Constrained optimization: Optimality conditions. Feasible methods. Penalty methods.
* Introduction to Linear Integer programming.
* "Branch and bound" algorithms. Lagrangian relaxation methods.

Bibliography :
"Programmation mathématique" - M. MINOUX
"Méthodes d'optimisation combinatoire" - A. GERMA, O. HUDRY
"Optimisation numérique. Aspects théoriques et pratiques" - J.F. BONNANS, J.C. GILBERT, C. LEMARECHAL, C. SAGASTIZABAL

Requirements :
Basics of analysis and linear algebra.

Organisation :

Evaluation :
Two-hour examination at the end of the semester.

Target :

Virtual Reality	INF09-RV
Number of hours : 26.00 h	2.00 ECTS credit
TD : 26.00 h	
Reference Teacher(s) : ARNALDI BRUNO	

Objectives :
This module is designed to explore the fundamentals of virtual reality.
Introduction to all the technologies exploited in the general context of interactive applications.
Particular interested is paid to the following three points:
Principles of real-time visualisation.
Principles of movement generation.
Principles of interaction.

Content :
*Real-time visualisation.
*Geometric modelling by plane polygonal facets. Graphic pipeline. Geometric transformation. Filtering. Depth-buffer algorithm. Smoothing. Lighting treatment. Links with hardware. Large data bases.
*Movement generation.
Classification of models. Descriptive models. Movement interpolation. Procedural animation. Model generator. Physical model, movement control.
*Interaction.
*Virtual-reality devices. Hardware configurations. Interaction paradigms and metaphors. Constraints on the application.

Bibliography :
J.D. Foley, A. Van Dam, ""Fundamentals of Interactives Computer Graphics"" (sec. Ed), Addison-Wesley, 1982.
Le Traité de la Realité Virtuelle, 2ème édition, Edition des Presses de l'Ecole Nationale des Mines de Paris, Volume 1 et Volume 2, Gratuit en version électronique pour les étudiants http://www.caor.ensmp.fr/interlivre

Requirements :
None.

Organisation :
Revision of class notes. Research: Documents and methods.

Evaluation :
Two-hour written examination at the end of the semester. Mark for project.

Target :

Motion Analysis and Gesture Recognition (2D / 3D)	INF09-AMRG
Number of hours : 26.00 h	2.00 ECTS credit
CM : 12.00 h, TP : 14.00 h	
Reference Teacher(s) : ANQUETIL ERIC	

Objectives :
Speakers : Eric Anquetil (Insa Rennes, Manager) -Richard Kulpa (Rennes 2 University) - Ludovic Hoyet (Inria)

With the development of touchscreen and motion capture technology, new human-computer interaction gains in popularity in the recent years. These approaches have been designed to take advantage of the interaction potential offered by 2D and 3D action gestures recognition. These gestural controls allow the user to execute many actions simply by doing Gestures. Recognition of human actions (2D and 3D action gestures) has recently become an active research topic in Computer Vision, Pattern Recognition and Man-Machine Interaction.
In this course, we address this emerging topic: Motion Analysis, Interpretation and Recognition of 2D and 3D Gestures for new Man-Machine Interactions. Technically, an action is a sequence generated by a human subject during the performance of a task. Action recognition deals with the process of labelling such motion sequence with respect to the depicted motions.
The course will expose the specificity of the recognition process of these two kinds of actions (2D and 3D action gestures) but also the potential convergence of the scientific approaches used for each of them. We will also discuss in this course the notions of animations, field of application for which the gestural commands can be fully exploited.

Content :
First part: Signal acquisition, Preprocessing and Normalization (Richard Kulpa)
* Pen-based and (Multi-)Touch Capture on touch screen: smartphone, tablet PC and tangible surface which support simultaneous participation of multiple users.
* Motion capture (MoCap) systems to extract body postures based on 3D joint positions and orientations by using markers and high precision camera array.
* Microsoft Kinect or Leap Motion sensor.
* Morphology-independent pre-processing
* Human skeleton modelling

Second part: Gesture Recognition (2D / 3D) (Eric Anquetil)
* 2D and 3D feature extraction
* Temporal, spatial, shape and motion relation modeling
* Segmented gesture recognition (Skeleton-based human action recognition)
* Recognition and Machine Learning Approaches:
o Graph modelling, DTW, HMM, SVM, NN…
o Reject Option…
* Unsegmented stream of gesture recognition.
o Temporal segmentation methods.
o Sliding Window approach.
* Man-Machine Interaction : Eager and lazy Recognition, Direct manipulation and indirect commands

Third part: Animation (Ludovic Hoyet)
* Direct and Inverse Kinematics (analytical and numerical methods)
* Interpolations (linear, splines, etc.)
* Motion Editing (motion warping, motion blending, transplanting, motion cleaning, etc.)
* Controlling Motions
o Finite State Machines
o Motions Graphs

Bibliography :
[1] A. Delaye and E. Anquetil, “Hbf49 feature set: A first unified baseline for online symbol recognition,” Pattern Recognition, vol. 46, no. 1, pp. 117–130, 2013.
[2] Z. Chen, E. Anquetil, H. Mouchère, and C. Viard-Gaudin, “Recognize multi-touch gestures by graph modeling and matching,” in 17th Biennial Conference of the International Graphonomics Society, Pointe-a`-Pitre, France, Jun. 2015.
[3] D. Rubine, “Specifying gestures by example,” in Proceedings of the 18th Annual Conference on Computer Graphics and Interactive Techniques, ser. SIGGRAPH ’91. New York, NY, USA: ACM, 1991, pp. 329–337.
[4] S. Macé and E. Anquetil, “Eager interpretation of on-line hand-drawn structured documents: The dali methodology,” Pattern Recognition, vol. 42, no. 12, pp. 3202–3214, Dec. 2009.

[5] M. Mu¨ller, T. Ro¨der, M. Clausen, B. Eberhardt, B. Kru¨ger, and Weber, “Documentation mocap database hdm05,” 2007.
[6] Said Yacine Boulahia, Eric Anquetil, Richard Kulpa, Franck Multon, HIF3D: Handwriting-Inspired Features for 3D Skeleton-Based Action Recognition, IEEE. 23rd International Conference on Pattern Recognition (ICPR 2016), Dec 2016, Cancun, Mexico.
[7] Zhaoxin Chen, Eric Anquetil, Harold Mouchère, Christian Viard-Gaudin, The MUMTDB dataset for evaluating simultaneous composition of structured documents in a multi-user and multi-touch environment, 15th International Conference on Frontiers in Handwriting Recognition, Oct 2016, Shenzhen, China
[8] L. Xia, C.-C. Chen, and J. Aggarwal, “View invariant human action recognition using histograms of 3d joints,” in IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pp. 20–27, 2012.
[9] M. A. Gowayyed, M. Torki, M. E. Hussein, and M. El-Saban, “Histogram of oriented displacements (hod): describing trajectories of human joints for action recognition,” in Proceedings of the International Joint Conference on Artificial Intelligence, pp. 1351–1357, 2013.
[10] R. Vemulapalli, F. Arrate, and R. Chellappa, “Human action recog- nition by representing 3d skeletons as points in a lie group,” in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 588–595, 2014.
[11] R. Chaudhry, F. Ofli, G. Kurillo, R. Bajcsy, and R. Vidal, “Bio- inspired dynamic 3d discriminative skeletal features for human action recognition,” in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, pp. 471–478,2013.
[12] H. Zhang and L. E. Parker, “Bio-inspired predictive orientation decomposition of skeleton trajectories for real-time human activity prediction,” in Proceedings of the IEEE International Conference on Robotics and Automation, pp. 3053–3060, 2015.
[13] R. Kulpa, F. Multon, and B. Arnaldi, “Morphology-independent representation of motions for interactive human-like animation,” in Computer Graphics Forum, vol. 24, pp. 343–351, 2005.
[14] A. Sorel, R. Kulpa, E. Badier, and F. Multon, “Dealing with vari- ability when recognizing user’s performance in natural 3d gesture interfaces,” International Journal of Pattern Recognition and Artificial Intelligence, vol. 27, no. 08, 2013.
[15] M. E. Hussein, M. Torki, M. A. Gowayyed, and M. El-Saban, “Human action recognition using a temporal hierarchy of covariance descriptors on 3d joint locations,” in Proceedings of the International Joint Conference on Artificial Intelligence, vol. 13, pp. 2466–2472, 2013.
[16] G. Evangelidis, G. Singh, and R. Horaud, “Skeletal quads: Human action recognition using joint quadruples,” in Proceedings of the IEEE International Conference on Pattern Recognition, pp. 4513– 4518, 2014.
[17] V. Bloom, D. Makris, and V. Argyriou. Clustered spatio- temporal manifolds for online action recognition. In Pattern Recognition (ICPR), 2014 22nd International Conference on, pages 3963–3968. IEEE, 2014.
[18] Y. Li, C. Lan, J. Xing, W. Zeng, C. Yuan, and J. Liu. Online human action detection using joint classification-regression recurrent neural networks. arXiv preprint arXiv:1604.05633, 2016.
[19] finger-count interaction: Combining multitouch gestures and menus”, International Journal of Human-Computer Studies, v.70 n.10, p.673-689, October, 2012.
[20] Sriganesh Madhvanath, Dinesh Mandalapu, Tarun Madan, Naznin Rao, Ramesh Kozhissery, “GeCCo: Finger gesture-based command and control for touch interfaces”, IHCI 2012: 1-6.
[21] Armin Bruderlin and Lance Williams. 1995. Motion signal processing. In Proceedings of the 22nd annual conference on Computer graphics and interactive techniques (SIGGRAPH '95), Susan G. Mair and Robert Cook (Eds.). ACM, New York, NY, USA, 97-104.
[22] Andrew Witkin and Zoran Popovic. 1995. Motion warping. In Proceedings of the 22nd annual conference on Computer graphics and interactive techniques (SIGGRAPH '95), Susan G. Mair and Robert Cook (Eds.). ACM, New York, NY, USA, 105-108.
[23] Charles Rose, Brian Guenter, Bobby Bodenheimer, and Michael F. Cohen. 1996. Efficient generation of motion transitions using spacetime constraints. In Proceedings of the 23rd annual conference on Computer graphics and interactive techniques (SIGGRAPH '96). ACM, New York, NY, USA, 147-154.
[24] Charles Rose, Michael F. Cohen, and Bobby Bodenheimer. 1998. Verbs and Adverbs: Multidimensional Motion Interpolation. IEEE Comput. Graph. Appl. 18, 5 (September 1998), 32-40.
[25] Michael Gleicher. 1998. Retargetting motion to new characters. In Proceedings of the 25th annual conference on Computer graphics and interactive techniques (SIGGRAPH '98). ACM, New York, NY, USA, 33-42.
[26] Lucas Kovar, Michael Gleicher, and Frédéric Pighin. 2002. Motion graphs. ACM Trans. Graph. 21, 3 (July 2002), 473-482.
[27] Lucas Kovar, John Schreiner, and Michael Gleicher. 2002. Footskate cleanup for motion capture editing. In Proceedings of the 2002 ACM SIGGRAPH/Eurographics symposium on Computer animation (SCA '02). ACM, New York, NY, USA, 97-104.

Requirements :
Object-oriented programming

Organisation :
This module will be articulated on a course (16h) which will be supported by a TP (10h), applying the notions of the course through a practical realization dealing with the capture of the gesture, its recognition and its use in the context of an animation challenge.

Evaluation :
The evaluation is based on a defense of the TP / project developed during the module. The presentation support and the developed code will be part of the requested deliverables.

Target :

Side channel attacks	INF09-SECU
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TP : 12.00 h	hand-out in English and course taught in English
Reference Teacher(s) : AVOINE GILDAS	

Objectives :
Learn the fundamentals of hardware-based and software-based side channel attacks and their countermeasures.

Content :
The course on “Side-channel attacks” addresses the specificities of software and hardware systems that lead to side-channel attacks. To keep in touch with real-life concerns as well as state-of-the art research, the course is taught by an engineer-researcher from the French ministry of defense (DGA-MI) whose activities are related to embedded cryptography, and a full-time CNRS researcher whose research is related to micro-architectural attacks.

The course considers techniques for secure implementations, physical attacks on microcircuits (timing and power side-channel attacks, fault injection attacks, etc.), as well as software-based attacks on micro-architecture of modern CPUs (side-channel attacks on caches and fault attacks on DRAM, etc.).

Bibliography :

Requirements :
The courses “engineering cryptography” and “operating system” from INSA Rennes (4INFO), or any other equivalent courses.

Organisation :
A large part of the course is devoted to hands-on sessions.

Evaluation :
Theoretical examination in a computer room, with an additional (randomly chosen) lab presentation.

Target :
5 INFO

Protocols verification	INF09-PROTOCOL
Number of hours : 26.00 h	2.00 ECTS credit
CM : 20.00 h, EP : 6.00 h	
Reference Teacher(s) : FILA BARBARA	

Objectives :
The objective of this course is to provide students with an in-depth knowledge regarding methods and tools for the specification, design, and symbolic verification of security protocols in various domains.

After a successful completion of this course, the students should be able to:
- Specify a protocol in a suitable formal framework;
- Formally define the security property against which the protocol should be checked;
- Select an appropriate verification tool to analyze the protocol;
- Detect logical flaws in improperly designed or implemented protocols.

Content :
The following topics will be covered in this course:
* Formal ways of specifying a protocol: Alice & Bob notation, message sequence charts, process algebra, Horn clauses, constraint systems, applied pi calculus;
* Attacker models: passive and active attackers, Dolev-Yao adversary, knowledge inference;
* Formal specification of security properties: trace properties, indistinguishability properties, equivalence properties, weak and strong secrecy, authentication (aliveness, agreement, synchronization), anonymity;
* Man-in-the-middle attacks;
* Protocol verification with a bounded number of sessions: constraint systems;
* Protocol verification with an unbounded number of sessions: Horn Clauses;
* Tools for automatic verification of security protocols: get started with Scyther, go deeper with ProVerif.

Bibliography :
- Cas Cremers and Sjouke Mauw. Operational Semantics and Verification of Security Protocols, Springer 2012, ISBN: 978-3-540-78635-1 (Print) 978-3-540-78636-8 (Online).
- Véronique Cortier, Steve Kremer. Formal Models and Techniques for Analyzing Security Protocols: A Tutorial. Foundations and Trends in Programming Languages 1(3): 151-267 (2014).

Requirements :
Introduction to security course 3INFO

Organisation :
Studying course work; personal work on the project.
This course will partially be taught in English.

Evaluation :
- Two-hour written examination (2/3 of teh final grade)
- Project (1/3 of teh final grade)

Target :
5info - Security track

Big Data Algorithms	INF09-ALGODATA
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 8.00 h, TP : 4.00 h	
Reference Teacher(s) : COSTAN ALEXANDRU	

Objectives :
The goal of this course is tu study how to analyze, organize and present Big Data in order to address their specific challenges: reduce the complexity, process the data deluge in real time, propose new paradigms to allow the extraction of relevant knowledge. The course focuses on the main design principles of the fundamental algorithms for Big Data processing. In particular, we will study algorithms for stream processing, social networks, recommandation systems, classification, trend detection and sentiment analysis.

Content :
- Graph theory and social networks
- Sentiment analysis and trend detection
- Stream processing
- Classification algorithms
- Recommandation algorithms
- Fake news detection
- Clustering algorithms

Bibliography :
B. Howe, Introduction to Data Science
R. Swan, J. Allan, Automatic Generation of Overview Timelines
H.R. Varian, H. Choi, Predic;ng the Present with Google Trends, Google Research Blog
J. Allan, R. Papka, V. Lavrenko, On-line New Event Detection and Tracking
R. Bandari, S. Asur, B. Huberman, The Pulse of News in Social Media: Forecasting Popularity

Requirements :
Database and systems (cloud, parallelism) concepts, Java programming skills. Knowledge of Apache Hadoop and Apache Spark.

Organisation :
Lectures and practical labs.

Evaluation :
Grading of practical labs.

Target :
Students interested in becoming data scientists, big data analysts, social networks experts.

Big Data Project	INF09-PRDATA
Number of hours : 26.00 h	2.00 ECTS credit
EP : 26.00 h	
Reference Teacher(s) : COSTAN ALEXANDRU	

Objectives :
The goal of the project is to support with a hands-on experience the challenges seen in the Big Data courses, with a particular focus on social networks, mobiles and analytics challenges. The objective is to master the know-how needed to addresses various real-life use-cases.

Content :
- Social networks applications
- Bioinformatics applications
- Big Data analytics

Bibliography :
Apache Spark
Apache Flink
Apache Beam

Requirements :
Database and systems (cloud, parallelism) concepts, Java programming skills. Knowledge of Apache Hadoop and Apache Spark.

Organisation :
Project sessions.

Evaluation :
Evaluation of the project defence.

Target :
Students interested in becoming data scientists, big data analysts, social networks experts.

Project in large-scale systems	INF09-PRSLE
Number of hours : 26.00 h	2.00 ECTS credit
CM : 2.00 h, EP : 24.00 h	
Reference Teacher(s) : PARLAVANTZAS NIKOLAOS	

Objectives :
This project involves realising and evaluating a large-scale system using modern technologies, such as cloud computing and multicore architectures. The objective is to allow students to deepen their knowledge of the techniques seen in the modules of the Large-Scale Systems option.

Content :
- Cloud infrastructures
- Scientific computing
- Internet of Things

Bibliography :

Requirements :
Knowledge in cloud computing, parallelism, and networks

Organisation :
Project sessions

Evaluation :
Project defence

Target :
Students interested in careers as research and DevOps engineers

Distributed Algorithms	INF09-AD
Number of hours : 26.00 h	2.00 ECTS credit
CM : 14.00 h, TD : 4.00 h, TP : 8.00 h	
Reference Teacher(s) : BERTIER MARIN	

Objectives :
* This module presents the basic concepts of parallelism and distributed computing for programming and algorithms to
complement the presentation of the low-level mechanisms seen in the fourth year "systems" module.
* Basic concepts are studied and illustrated through examples of parallel languages like Java as well as through the use of middleware and widely used libraries of communication (Java RMI, CORBA, MPI).
* The concepts and problems associated with algorithms and synchronisation are tackled.

Content :
PARALLELISM
* Execution parallelism and parallel machine. Parallelism of expression.
COMMUNICATING PROCESS BY VARIABLE SHARING
* Java threads.
* Java semaphore. Synchronisation monitors and synchronous methods.
* Software engineering and parallelism in Java.
DISTRIBUTED PROCESS
* Remote Procedure Call: Customer-server model. N-tier.
* RMI Java programming. CORBA remote method call.
* Communicating process by message exchanges: MPI
DISTRIBUTED ALGORITHMS
* Time.
* Global state.
* Election. Consensus.
PEER-TO-PEER MODEL: JXTA.
CONCLUSION.

Bibliography :
La programmation parallèle : outils, méthodes et éléments de mise en oeuvre.J.-P. Banâtre. Eyrolles, 1991.
Algorithmes et architectures parallèles Michel Cosnard, Denis Trystram. InterEditions 1993.
Concurrent Programming in Java: Design
Principles and Patterns, Doug Lea, 2e édition Addison-Wesley, 1999.

Requirements :
Experience with C and Java languages.
Good knowledge of operating systems (process, threads, semaphores).

Organisation :
Revision of lecture notes. Preparation of practical work. Further research on the student's own initiative.

Evaluation :
Two-hour written examination.

Target :

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in a professional or social context.
- Obtaining or reinforcing C1 level, strongly advised/recommended by the CTI. t.

Content :
- Learning by doing: students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
- Expressing oneself accurately and fluently: students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
1. English Grammar in Use (Cambridge University Press)
2. Dictionnaire Collins Cobuild
3. Polycopié de l' INSA

Requirements :
Having taken and passed the TOEIC test during the previous two years (800 required)
or any other B2 certification recognized by the CTI.

Organisation :
- Each class lasts one hour and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
- Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet.

Evaluation :
Continuous assessment: The final mark (out of 20) will be based on the attendance rate and the personal implication of the student during the class.

Target :

TOEIC 5th year	HUM09-ANGL-TOEIC
Number of hours : 20.00 h	1.50 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in company and business context.
- Obtaining or reinforcing the B2 level requested by the CTI.
- Obtaining 800 score at the final TOEIC test.

Content :
Learning by doing : students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
Expressing oneself accurately and fluently : students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
- English grammar in Use, Intermediate Edition (CUP)
- Robert and Collins bilingual dictionary or Collins Cobuild

Requirements :
Not having already taken and passed the TOEIC test during the previous two years
B1/B2 level advised

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet. B2 level tests are also taken throughout the course.

Evaluation :
Final mark based on :
TOEIC score at final exam + attendance (more than 4 non justified absences result in 0/20 mark).

Target :
5th year students who haven't already passed their TOEIC

Economics, Law and Business Studies A (Lean six sigma)	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
* Lean Six Sigma (28h / in French)
Lean Six Sigma is a methodology that enables firms to make their processes more effective and efficient. It¿s the current industry standard for process improvement designed to reduce waste and enhance output quality.

* Law (8h / in French)
Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies B (Human Resource Management)	HUM09-PM-B
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
* Human Resource Management (20h / in French)
    - Main current challenges of Human Resource Management
    - Human Resource Management¿s tools and organization
    - Focus on how team managers deal with Human Resource Management

* Law (8h / in French)
    Main principles of the French legal system

* Social legislation (8h / in French)
    Main principles of French social legislation
    Employment contract

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies C (Human Resources Management)	HUM09-PM-C
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
* Human Resource Management (20h / in French)
    - Main current challenges of Human Resource Management
    - Human Resource Management¿s tools and organization
    - Focus on how team managers deal with Human Resource Management

* Law (8h / in French)
    Main principles of the French legal system

* Social legislation (8h / in French)
    Main principles of French social legislation
    Employment contract

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies D (MANAGEMENT - ETHICS - RESPONSIBILITY)	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :
This course aims at enabling students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
The program's main objective is to provide a multidisciplinary approach to the field of innovation, strategy and industrial design. This course will give an overview of the innovative process.
During this program, participants will have the opportunity to explore a business case covering the first stage of a product development project.

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - S7 and S8

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies E (International Strategy and Development)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time.

Content :
This course provides students with the tools necessary to understand and work effectively in today's international economic environment. It explores how innovative firms address new markets and compete outside their national frontiers. The course focuses on strategic choices regarding effective actions in international business.

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advice to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
- Project Management (28 h / in French)
    - Efficient Project Management tools and organization according to PMI (Project Management Institute)
    - Agility
    - SCRUM

- Law (8 h / in French)
    Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advice to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Evaluation stage	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies G (serious game)	HUM09-PM-G
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	course taught in English
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
-Establishing a strong, specific vocabulary base
-Understanding the main issues that industrial companies deal with (in a specific management field).
-Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
* Business Simulation (serious game) (28h / in English)
The business simulation ¿Global Challenge¿ (a CESIM product) has been designed to improve the understanding and knowledge of the complexity of global business operations in a dynamic, competitive environment. It focuses on strategic management, international management and business policy.
The task for the student teams is to manage a global mobile telecommunications company as its technology and markets evolve. Students will develop and execute strategies for their simulated company operating in the USA, Asia, and Europe.
The simulation is based on an online platform that allows students to play in their own language (many languages available: English, Spanish, Portuguese, Chinese,¿).

* Law (8h / in French)
Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Societal responsibility of business	EII09-HUMT
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Evaluation stage	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Legal Training for Engineers	INF09-DROIT
Number of hours : 20.00 h	2.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) :	

Objectives :
To give to final-year engineers, whether or not in project manager positions, the key legal concepts for understanding the protection of intellectual creations and software, the contractual mechanisms for producing software content, and the terms of software licenses.

Content :
5 independent modules CM1 to CM5

CM1: COMPUTER CREATIONS AND ACTORS

CM 2: GENERIC CONTRACTUAL STRUCTURES AND RESPONSIBILITIES

CM 3: SPECIFIC CONTRACTUAL STRUCTURES

CM 4: SOFTWARE LICENSES (INCLUDING GPL)

CM 5: CREATION AND ADMINISTRATION OF WEB SITES

Bibliography :
On the internet : http://www.legalis.net/

Books : Informatique, T_l_coms, Internet - Ed Francis Lefebvre 2012

Requirements :
passing the introductory module to general law (8H Lectures)

Organisation :
Lectures (7 x 2H)

Evaluation :
final exam

Target :

Conferences	SRC09-SPEC
Number of hours : 16.00 h	1.00 ECTS credit
CM : 16.00 h, CM : 16.00 h	
Reference Teacher(s) :	

Objectives :
Teaching students the fundamentals of Project Management and practice within specific projects.

Content :
Project's Organization
Planning, analysis and formalization of individual and team goals.
Methodological tools for project management
Analysis of deviations from the specifications
Risk Management
All the concepts covered in this course will be applied to a specific case study within dedicated projects (SRC09 TCBE
module).

Bibliography :

Requirements :

Organisation :

Evaluation :
Oral defense of the project (Implementation of the lecture's concepts)

Target :

SRC09-CONFERENCES	SRC09-CONF
Number of hours : 16.00 h	1.00 ECTS credit
CM : 16.00 h, CM : 16.00 h	
Reference Teacher(s) : PREVOTET JEAN-CHRISTOPHE	

Objectives :
Industrial or academic experts in various domains present small talks (typically 2h) about technical and scientific issues in their domain. The main idea is to open students to the world of industry and research and make them sensitive to state of the art issues.

Content :
The talks may vary depending on the availability of experts

Bibliography :

Requirements :

Organisation :

Evaluation :
PASS if every session is attended, FAIL otherwise.

Target :
5SRC and 5M&N

Semestre 9

Parcours Master Science Informatique

1	**INF09-SIF**		**Research in Computer Science**	**24.50**
	INF09-SIF	O	Average's Research master in Computer Science	23.00
	INF09-BIBL	O	Bibliography	1.50
2	**HUM09**		**Non-scientific syllabus S9**	**5.50**
	HUM09-ANGL-CONV	C	English S9 Conversation	1.50
	HUM09-ANGL-TOEIC	C	TOEIC 5th year	1.50
	HUM09-PM-A	C	Economics, Law and Business Studies A (Lean six sigma)	2.00
	HUM09-PM-B	C	Economics, Law and Business Studies B (Human Resource Management)	2.00
	HUM09-PM-C	C	Economics, Law and Business Studies C (Human Resources Management)	2.00
	HUM09-PM-D	C	Economics, Law and Business Studies D (MANAGEMENT - ETHICS - RESPONSIBILITY)	2.00
	HUM09-PM-E	C	Economics, Law and Business Studies E (International Strategy and Development)	2.00
	HUM09-PM-F	C	Economics, Law and Business Studies F (sustainable development)	2.00
	EII09-EVST	C	Evaluation stage	1.00
	HUM09-PM-G	C	Economics, Law and Business Studies G (serious game)	2.00
	EII09-HUMT	C	Societal responsibility of business	1.00
	EII09-EVST	C	Evaluation stage	1.00
	INF09-DROIT	C	Legal Training for Engineers	2.00
	SRC09-SPEC	C	Conferences	1.00
	SRC09-CONF	C	SRC09-CONFERENCES	1.00

O = compulsary, C= in choice , F= optional

Average's Research master in Computer Science	INF09-SIF
Number of hours : 360.00 h	23.00 ECTS credit
CM : 0.00 h	
Reference Teacher(s) : GOURANTON VALERIE	

Objectives :
The aim of the 3rd semester of the MRI specialism is to provide each student with advanced knowledge in one research field, together with the broad bases applicable to all the various thematic tracks. It also gives students training in research methodology through the presentation of various aspects of this field, including oral and written scientific presentation techniques.
It is made up of a core syllabus and the 5 course units of the thematic track chosen by the student from the 9 tracks available at the consortium sites.

http://master.irisa.fr/index.php/en/

Content :
The core syllabus consists of:
* 2 course units (20 hours and 4 ECTS credits each) chosen by the student from the 3 available; students attend these courses either at the local site or remotely via video-conference. The aim of these core course units is to provide a broad background to the various research subjects;
* 1 course unit on a methodological approach to research (PROF - 0 ECTS credits): one course unit on the writing of scientific papers (RAS); a series of lectures (CONF) in which presentations are given about academic and industrial research professions, the organization of research, and various specific research fields;
* COLQ (2 ECTS credits), a course unit to prepare students for giving oral presentations, which includes the colloquium of the MRI specialism, giving all students the opportunity to present a scientific paper in a set amount of time, based on the internship carried out during semester 4.

Bibliography :

Requirements :

Organisation :
Each track is made up of 5 set course units of 20 hours each (4 ECTS credits) established by the teaching staff. Depending on the track, one of the 5 course units, as indicated by the track's teaching staff, may be chosen from a selection of course units offered in the other tracks.

Evaluation :
The core syllabus course units are assessed by a final written examination. They also require individual work (around the same volume of work as the course itself), based on the reading of papers suggested by the teaching staff. These course units may develop over the years. Each course unit from the thematic tracks is assessed by continuous assessment , based on summaries of research articles and homework-type tasks, etc. The individual work required for this type of course unit is around 150% of the volume of teaching for each unit.

Target :

Bibliography	INF09-BIBL
Number of hours : 40.00 h	1.50 ECTS credit
TD : 9.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

English S9 Conversation	HUM09-ANGL-CONV
Number of hours : 10.00 h	1.50 ECTS credit
TD : 10.00 h, TD : 10.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in a professional or social context.
- Obtaining or reinforcing C1 level, strongly advised/recommended by the CTI. t.

Content :
- Learning by doing: students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
- Expressing oneself accurately and fluently: students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
1. English Grammar in Use (Cambridge University Press)
2. Dictionnaire Collins Cobuild
3. Polycopié de l' INSA

Requirements :
Having taken and passed the TOEIC test during the previous two years (800 required)
or any other B2 certification recognized by the CTI.

Organisation :
- Each class lasts one hour and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
- Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet.

Evaluation :
Continuous assessment: The final mark (out of 20) will be based on the attendance rate and the personal implication of the student during the class.

Target :

TOEIC 5th year	HUM09-ANGL-TOEIC
Number of hours : 20.00 h	1.50 ECTS credit
TD : 20.00 h, TD : 20.00 h	
Reference Teacher(s) : LE VOT PHILIPPE	

Objectives :
- Improving communication skills in everyday life situations as well as in company and business context.
- Obtaining or reinforcing the B2 level requested by the CTI.
- Obtaining 800 score at the final TOEIC test.

Content :
Learning by doing : students will have to be able to speak and listen, write a document while showing they can solve problems, reason, convince and demonstrate in an articulate manner.
Expressing oneself accurately and fluently : students will engage in activities requiring creative and reactive skills such as debates, role-plays, individual oral Power Point presentations, projects, based on scientific topics and current events.

Bibliography :
- English grammar in Use, Intermediate Edition (CUP)
- Robert and Collins bilingual dictionary or Collins Cobuild

Requirements :
Not having already taken and passed the TOEIC test during the previous two years
B1/B2 level advised

Organisation :
Each class lasts two hours and most classrooms are equipped with video and audio. A multimedia lab and computer rooms are also available for the students to work in a stimulating environment.
Teaching resources include press articles, audio and video documents (TV reports, extracts from films and series) as well as the Internet. B2 level tests are also taken throughout the course.

Evaluation :
Final mark based on :
TOEIC score at final exam + attendance (more than 4 non justified absences result in 0/20 mark).

Target :
5th year students who haven't already passed their TOEIC

Economics, Law and Business Studies A (Lean six sigma)	HUM09-PM-A
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
* Lean Six Sigma (28h / in French)
Lean Six Sigma is a methodology that enables firms to make their processes more effective and efficient. It¿s the current industry standard for process improvement designed to reduce waste and enhance output quality.

* Law (8h / in French)
Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies B (Human Resource Management)	HUM09-PM-B
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
* Human Resource Management (20h / in French)
    - Main current challenges of Human Resource Management
    - Human Resource Management¿s tools and organization
    - Focus on how team managers deal with Human Resource Management

* Law (8h / in French)
    Main principles of the French legal system

* Social legislation (8h / in French)
    Main principles of French social legislation
    Employment contract

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies C (Human Resources Management)	HUM09-PM-C
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field)
- Understanding the importance of teamwork: making collective decisions and producing the expected work in time

Content :
* Human Resource Management (20h / in French)
    - Main current challenges of Human Resource Management
    - Human Resource Management¿s tools and organization
    - Focus on how team managers deal with Human Resource Management

* Law (8h / in French)
    Main principles of the French legal system

* Social legislation (8h / in French)
    Main principles of French social legislation
    Employment contract

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies D (MANAGEMENT - ETHICS - RESPONSIBILITY)	HUM09-PM-D
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :
This course aims at enabling students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
The program's main objective is to provide a multidisciplinary approach to the field of innovation, strategy and industrial design. This course will give an overview of the innovative process.
During this program, participants will have the opportunity to explore a business case covering the first stage of a product development project.

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - S7 and S8

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies E (International Strategy and Development)	HUM09-PM-E
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : GOURRET FANNY	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time.

Content :
This course provides students with the tools necessary to understand and work effectively in today's international economic environment. It explores how innovative firms address new markets and compete outside their national frontiers. The course focuses on strategic choices regarding effective actions in international business.

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advice to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Economics, Law and Business Studies F (sustainable development)	HUM09-PM-F
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
- Establishing a strong, specific vocabulary base
- Understanding the main issues that industrial companies deal with (in a specific management field).
- Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
- Project Management (28 h / in French)
    - Efficient Project Management tools and organization according to PMI (Project Management Institute)
    - Agility
    - SCRUM

- Law (8 h / in French)
    Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advice to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Evaluation stage	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Economics, Law and Business Studies G (serious game)	HUM09-PM-G
Number of hours : 34.00 h	2.00 ECTS credit
CM : 30.00 h, CM : 30.00 h, TD : 4.00 h, TD : 4.00 h	course taught in English
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :
This course aims to enable students to develop specific management skills in accordance with their personal objectives and professional motivations. Students chose one option among six.

Main learning outcomes are:
-Establishing a strong, specific vocabulary base
-Understanding the main issues that industrial companies deal with (in a specific management field).
-Understanding the importance of teamwork : making collective decisions and producing the expected work in time

Content :
* Business Simulation (serious game) (28h / in English)
The business simulation ¿Global Challenge¿ (a CESIM product) has been designed to improve the understanding and knowledge of the complexity of global business operations in a dynamic, competitive environment. It focuses on strategic management, international management and business policy.
The task for the student teams is to manage a global mobile telecommunications company as its technology and markets evolve. Students will develop and execute strategies for their simulated company operating in the USA, Asia, and Europe.
The simulation is based on an online platform that allows students to play in their own language (many languages available: English, Spanish, Portuguese, Chinese,¿).

* Law (8h / in French)
Main principles of the French legal system

Bibliography :
Given during the course

Requirements :
ECONOMICS AND BUSINESS MANAGEMENT - 1
ECONOMICS AND BUSINESS MANAGEMENT - 2

Organisation :
This course is opened to students with different engineering backgrounds. Students work together in small groups and gather the necessary information and advices to set out a final report. Groups also benefit from conferences and tutorial sessions performed by professional speakers.

Evaluation :
Continuous assessment (collective work)

Target :

Societal responsibility of business	EII09-HUMT
Number of hours : 20.00 h	1.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) : BOUGUENNEC CHRISTELLE	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Evaluation stage	EII09-EVST
Number of hours : 5.00 h	1.00 ECTS credit
EP : 1.00 h, EP : 1.00 h, TA : 4.00 h, TA : 4.00 h	
Reference Teacher(s) :	

Objectives :

Content :

Bibliography :

Requirements :

Organisation :

Evaluation :

Target :

Legal Training for Engineers	INF09-DROIT
Number of hours : 20.00 h	2.00 ECTS credit
CM : 20.00 h, CM : 20.00 h	
Reference Teacher(s) :	

Objectives :
To give to final-year engineers, whether or not in project manager positions, the key legal concepts for understanding the protection of intellectual creations and software, the contractual mechanisms for producing software content, and the terms of software licenses.

Content :
5 independent modules CM1 to CM5

CM1: COMPUTER CREATIONS AND ACTORS

CM 2: GENERIC CONTRACTUAL STRUCTURES AND RESPONSIBILITIES

CM 3: SPECIFIC CONTRACTUAL STRUCTURES

CM 4: SOFTWARE LICENSES (INCLUDING GPL)

CM 5: CREATION AND ADMINISTRATION OF WEB SITES

Bibliography :
On the internet : http://www.legalis.net/

Books : Informatique, T_l_coms, Internet - Ed Francis Lefebvre 2012

Requirements :
passing the introductory module to general law (8H Lectures)

Organisation :
Lectures (7 x 2H)

Evaluation :
final exam

Target :

Conferences	SRC09-SPEC
Number of hours : 16.00 h	1.00 ECTS credit
CM : 16.00 h, CM : 16.00 h	
Reference Teacher(s) :	

Objectives :
Teaching students the fundamentals of Project Management and practice within specific projects.

Content :
Project's Organization
Planning, analysis and formalization of individual and team goals.
Methodological tools for project management
Analysis of deviations from the specifications
Risk Management
All the concepts covered in this course will be applied to a specific case study within dedicated projects (SRC09 TCBE
module).

Bibliography :

Requirements :

Organisation :

Evaluation :
Oral defense of the project (Implementation of the lecture's concepts)

Target :

SRC09-CONFERENCES	SRC09-CONF
Number of hours : 16.00 h	1.00 ECTS credit
CM : 16.00 h, CM : 16.00 h	
Reference Teacher(s) : PREVOTET JEAN-CHRISTOPHE	

Objectives :
Industrial or academic experts in various domains present small talks (typically 2h) about technical and scientific issues in their domain. The main idea is to open students to the world of industry and research and make them sensitive to state of the art issues.

Content :
The talks may vary depending on the availability of experts

Bibliography :

Requirements :

Organisation :

Evaluation :
PASS if every session is attended, FAIL otherwise.

Target :
5SRC and 5M&N

Semestre 10

Parcours Contrat de professionalisation

1	INF-PFE10		End of studies Internship	30.00
	INF10-PFE	O	End of Studies Project	30.00

O = compulsary, C= in choice , F= optional

End of Studies Project	INF10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ST : 346.00 h	
Reference Teacher(s) : CELLIER-BELLINA PEGGY	

Objectives :
The final internship (PFE) takes place in companies or in research laboratories for a period of at least 16 weeks and at most 26 weeks (6 months).
The final internship is a good exercise for students in order to prepare them to the integration in the working world. They can go
further in the notion of management and software engineering already study during the project of the 4th year. The studant has to contact the companies and be interviewed. It is a good preparation for job search.
Students must write a report during their internship and prepare a presentation.

Content :
Examples of previous internship subjects:
* Development of an interactive map-based application for reporting and analysis of cellular network coverage on tablets.
* Workflow for managin dialogues with subscribers of e-mail marketing system
* Development of a raster library and rocessing tool/calculator for 3D rasters.
* Study of the security on internet, threats and solutions.
* Development af an Android game.
* Elaboration of models of natural language for handwritting recognition.
* Development of an administrative tool for the fraud department.

Bibliography :

Requirements :
Students must draw upon their experience of five semesters specialising in computer science.

Organisation :
The student integrates the company on a full-time basis.
While working at the company, the student has to write the report and prepare the presentation.

Evaluation :
Mark awarded by the internship supervisor for work accomplished.
Mark for the report.
Mark for the presentation.

Target :

Semestre 10

Parcours Formation Initiale INFO

1	INF-PFE10		End of studies Internship	30.00
	INF10-PFE	O	End of Studies Project	30.00

O = compulsary, C= in choice , F= optional

End of Studies Project	INF10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ST : 346.00 h	
Reference Teacher(s) : CELLIER-BELLINA PEGGY	

Objectives :
The final internship (PFE) takes place in companies or in research laboratories for a period of at least 16 weeks and at most 26 weeks (6 months).
The final internship is a good exercise for students in order to prepare them to the integration in the working world. They can go
further in the notion of management and software engineering already study during the project of the 4th year. The studant has to contact the companies and be interviewed. It is a good preparation for job search.
Students must write a report during their internship and prepare a presentation.

Content :
Examples of previous internship subjects:
* Development of an interactive map-based application for reporting and analysis of cellular network coverage on tablets.
* Workflow for managin dialogues with subscribers of e-mail marketing system
* Development of a raster library and rocessing tool/calculator for 3D rasters.
* Study of the security on internet, threats and solutions.
* Development af an Android game.
* Elaboration of models of natural language for handwritting recognition.
* Development of an administrative tool for the fraud department.

Bibliography :

Requirements :
Students must draw upon their experience of five semesters specialising in computer science.

Organisation :
The student integrates the company on a full-time basis.
While working at the company, the student has to write the report and prepare the presentation.

Evaluation :
Mark awarded by the internship supervisor for work accomplished.
Mark for the report.
Mark for the presentation.

Target :

Semestre 10

Parcours Master Science Informatique

1	INF-PFE10		End of studies Internship	30.00
	INF10-PFE	O	End of Studies Project	30.00

O = compulsary, C= in choice , F= optional

End of Studies Project	INF10-PFE
Number of hours : 350.00 h	30.00 ECTS credit
ES : 4.00 h, ST : 346.00 h	
Reference Teacher(s) : CELLIER-BELLINA PEGGY	

Objectives :
The final internship (PFE) takes place in companies or in research laboratories for a period of at least 16 weeks and at most 26 weeks (6 months).
The final internship is a good exercise for students in order to prepare them to the integration in the working world. They can go
further in the notion of management and software engineering already study during the project of the 4th year. The studant has to contact the companies and be interviewed. It is a good preparation for job search.
Students must write a report during their internship and prepare a presentation.

Content :
Examples of previous internship subjects:
* Development of an interactive map-based application for reporting and analysis of cellular network coverage on tablets.
* Workflow for managin dialogues with subscribers of e-mail marketing system
* Development of a raster library and rocessing tool/calculator for 3D rasters.
* Study of the security on internet, threats and solutions.
* Development af an Android game.
* Elaboration of models of natural language for handwritting recognition.
* Development of an administrative tool for the fraud department.

Bibliography :

Requirements :
Students must draw upon their experience of five semesters specialising in computer science.

Organisation :
The student integrates the company on a full-time basis.
While working at the company, the student has to write the report and prepare the presentation.

Evaluation :
Mark awarded by the internship supervisor for work accomplished.
Mark for the report.
Mark for the presentation.

Target :