Relevant Courses Descriptions taken at

School of Engineering and Architecture of Fribourg, Switzerland
Bachelor

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1 1st year

1.1 Mathematics – 14 ECTS

1.1.1 Linear Algebra 1 – 3.5 ECTS – Swiss grade 4.7/6

Algèbre linéaire 1 in german given by Christophe Hebeisen

Trigonometry, vector and analytical geometry:

- Trigonometric circle and trigonometric functions
- Trigonometric equations and inequalities
- The different vector products and their applications
- Analytical equations of line, plane, circle and spheres

Complex numbers:

- Representations of complex numbers (Cartesian, trigonometric, exponential form)
- The Gauss Plan
- Solving complex equations
- Applications in the Gauss plane and complex elementary functions

1.1.2 Linear Algebra 2 – 3.5 ECTS – Swiss grade 4.8/6

Algèbre linéaire 2 in german given by Markus Geuss

Systems of linear equations and matrix calculation:

- N-dimensional vectors, scalar product and standard
- Gaussian algorithm and reduction of systems of linear equations to the stepped shape
- Matrix representation of a system of linear equations and matrix calculation
- Discussion of under-determined systems of linear equations
- Least squares (multi-)linear regression

Linear applications:

- Transformations of space (expansion, rotation, projections, symmetries and their compounds)
- Base change and passage matrix
- Own vectors and own values
- Diagonalization and applications

1.1.3 Calculus 1 – 3.5 ECTS – Swiss grade 4.6/6

Analyse 1 in german given by Micha Wasem

Functions, limits and continuity:

- Functions (algebraic, trigonometric, transcendental, piecewise, ...)
- Composition of functions
- Reciprocal functions
- Intuitive definition of the limit and continuity of a function
- Properties

Derivatives and applications:

- Slope of a tangent and definition of the derivative
- Derivation techniques (rules, chain derivation, implicit, ...)
- Extreme values of a continuous function, growth and concavity
- Optimization and related rates
- Differential and linear approximation
- Hospital Rule

1.1.4 Calculus 2 – 3.5 ECTS – Swiss grade 4.9/6

Analyse 2 in german given by Micha Wasem

Complete:

- Primitives of a function and indefinite integral
- Riemann sum and defined integral
- Fundamental theorem and integration techniques
- Introduction to differential equations
- Applications: calculation of areas in the plane, lengths, volumes and areas of revolution, concepts of work.
- Improper integrals

Infinite series:

- Consequences and their limits
- Definitions and convergence criteria for the series
- Taylor Series

1.2 Basic computing Science – 17 ECTS

1.2.1 Programming – 6.5 ECTS – Swiss grade 5.1/6

Programmierung in german given by Jacques Supcik

Introduction to Programming:

- Concept of computer (architecture, main components) and program
- Development: steps, tools used, files involved, work environment
- Mastering the basic functions of a development environment (editing, compiling, debugging)
- Concepts of type and variable; distinction between primitive type and reference type
- Instructional and Program Concepts

Programming in Java:

- Language basics, identifiers, reserved words, variables, primitive types, expressions and assignments
- Control structures: sequence, selection (if..else and switch instructions)
- Instructions itératives (while, do..while and for loops)
- Methods and functions (specification, implementation, use); parameter passing
- One- and multidimensional tables
- Creating and manipulating strings
- Exception generation, handling and propagation
- Simple inputs/outputs (I/O), flow concepts, reading and writing text files
- Classes and objects
- Packages and access control
- Static members (fields and methods)
- Concept of inheritance and creation of subclasses

- Abstract classes and interfaces
- Classes internes, anonymes
- Expressions lambdas
- General
- Stream (flow-based programming)

1.2.2 Algorithmics and Data Structures – 6.5 ECTS – Swiss grade 5.3/6

Algorithmen in german given by Andreas Fischer

Course content included:

- Notion of algorithm and complexity analysis.
- Notion of abstract type, case studies (stack, queues, chained list, set, hash tables, bitsets, priority queue, introduction to trees and graphs).
- Programming techniques (recursivity, chaining, dynamic programming, error processing, genericity, probabilistic algorithms, examples of backtracking).
- Some classical algorithms (sorting, binary search, random numbers, hash, RSA cryptography...).
- Problem-solving approach, program specification by PRE/POST-conditions, program testing, systematic fight against bugs, numerical problems in programming, measurement of execution time

1.2.3 Human-Computer Interaction – 4 ECTS – Swiss grade 5/6

Interface Homme-Machine 1 in french given by Sandy Ingram

Course content included:

- Putting into practice the elements seen during programming: classes, abstract classes, interfaces, internal classes, enum, genericity, annotations, lambda expressions, method references, etc.
- Technical aspects related to the use of JavaFX (Stage, scene graphs, containers, UI components, properties, binding, event management, ...). Principles of event-driven programming.
- Using the SceneBuilder tool to generate graphical interfaces in declarative mode (XML / FXML format).
- Splitting of an application according to the Model-View-Controller (MVC) architecture.
- Drop-down and context-sensitive menus. Creation of keyboard shortcuts.
- Creation and use of general and specialized dialog boxes.
- Deployment of an application with external resources (images, sound, ...).
- General principles related to human-machine interaction, usability, ergonomic criteria and human factors.
- Ergonomic assessments: techniques and implementation.
- Elements related to visualization (icons, highlighting techniques, layout and alignment, screen templates, gaze path, layout, use of colors, definitions and typographical rules, ...).

1.3 Discrete Electronics – 8 ECTS

1.3.1 Discrete Electronics 1 – 4 ECTS – Swiss grade 5.1/6

Numerische Technik 1 in german given by Michael Mäder

Block TN1: Numbering, Combinatorial Systems:

- Binary numbers and arithmetic operations
- Logical operations and functions.
- Analysis and synthesis of combinatorial functions.
- Introduction to VHDL for combinatorial circuits.

Block TN2: Simple synchronous sequential systems:

- Analysis of sequential systems
- Synthesis of synchronous sequential systems

Practical work:

- Introduction to the laboratory and standard CMOS circuits
- Combinatorial circuit
- Physical synchronous circuit
- Technology, propagation time
- Use of an oscilloscope: measurement of voltages, time.
- Impedance matching: display of different voltages and signal propagation times.

1.3.2 Discrete Electronics 2 – 4 ECTS – Swiss grade 4.7/6

Numerische Technik 2 in german given by Michael Mäder

Block TN3: Advanced synchronous sequential systems:

- Analysis and synthesis of advanced sequential systems

Block TN4: Special systems and technology:

- Analysis and Synthesis of Sequential Asynchronous Systems.
- CMOS logic circuit technology.
- Arithmetic systems

Block TN5: Programmable Systems:

- Programmable circuits.
- Introduction to the VHDL description.

Practical work:

- Synchronous circuit in simulation
- Physical synchronous circuit
- Programming an FPGA

Integrated project, carried out in a group:

- Complete management of a group project (sessions, specifications/operating instructions, design, production, testing, documentation and presentation)

1.4 Networking – 8 ECTS

1.4.1 Networking 1 – 4 ECTS – Swiss grade 4.2/6

Téléinformatique 1 in german given by Rudolf Scheurer

Course content included:

- Network structure: topologies, architectures
- Internet/OSI Reference Model: definition, communication between layers, protocols, data units, services and service access point
- Physical layer: bit and moment rates, communication channel, physical media, transmission modes, multiplexing techniques
- Mechanisms and protocols for transmission error handling and flow control
- Information and coding: entropy and amount of information, channel coding, source coding

Practical work:

- Use of protocol analyzers
- LAN techniques (Ethernet)
- Asynchronous transmission (serial interface)
- Baseband transmission
- Source Coding (compression)
- Channel Coding (error checking with CRC)

1.4.2 Networking 2 – 4 ECTS – Swiss grade 5.4/6

Téléinformatique 2 in german given by Rudolf Scheurer

Course content included:

- Protocols and mechanisms of the data link, network and transport layers
- Local area network technologies: Ethernet/TCP/IP protocol stack
- Addressing: IPv4, classes, private addressing, introduction to IPv6
- Network elements: hubs, bridges, switches, routers, address servers, etc.
- Application protocols: e-mail, file transfer, virtual terminals, HTTP, etc.

Practical work:

- Data Layer Protocol (PPPoE)
- MAC/IP addressing (ARP)
- Internet: IP, ICMP, fragmentation
- Internet: UDP, TCP
- Internet applications: Telnet, HTTP, FTP, SMTP
- Address management with DHCP

1.5 Languages, communication and management – 13 ECTS

1.5.1 English 1 – 1.5 ECTS – Swiss grade 5.9/6

Anglais 1 in english given by Santiago Cruz

Emphasis is placed on all four language skill development areas, with a balance of language structure (grammar) and practical usage. More precisely:

- Emphasis is placed on all four language skill development areas, with a balance of language structure (grammar) and practical usage. More precisely:
- Enlarging and acquiring everyday vocabulary (Threshold level) as well as idiomatic expressions and colloquialisms;
- Practicing oral skills (listening and speaking) through systematic training and meaningful activities (such as tape listening, conversations, role-playing, presentations, etc.)
- Practicing writing skills for the industrial world (reading general and scientific/vocational texts, writing compositions, letters...)
- General approach to lifestyles and cultures of the English-speaking world.

Focus is on authentic material (wide range of accents, unrestricted vocabulary and natural speech, etc.) and teamwork.

1.5.2 English 2 – 1.5 ECTS – Swiss grade 5.3/6

Anglais 2 in english given by Santiago Cruz

Continuation and development of all activities defined in Module 1, but in addition:

- Business English knowledge, such as writing appropriate application (cover) letters and CVs (résumés), according not only to normal writing practice in the USA and UK, but also to Swiss and international regulations (both academic and corporate)

2 2^{nd} year

2.1 Mathematics and Sciences for Computer Scientists – 12 ECTS

2.1.1 Specialized Mathematics 1 – 3.5 ECTS – Swiss grade 5/6

Mathématiques spécifiques 1 in french given by Roseline Nussbaumer

Machine learning:

- Multivariate functions
- Gradient
- Optimization (under constraints)
- Gradient descent
- ...

Discrete Mathematics:

- Equity relationships
- Generating sets
- Linear recurrences
- First-order logic

2.1.2 Specialized Mathematics 2 – 3 ECTS – Swiss grade 5.4/6

Mathématiques spécifiques 2 in french given by Rudolf Riedi

Discrete Mathematics:

- Introduction to number theory (modules, primality tests etc.).
- Basics of Shannon's information theory.
- Bases de la cryptographie moderne ('public key', 'zero knowledge' etc.).

Digital Mathematics:

- Technique for searching zeros of non-linear functions
- Simplex algorithm
- Unavoidable errors on the computer (floating point numbers ...)
- Polynomial, linear, spline and Bézier curve interpolations

Formal aspects of languages:

- Notion of alphabet, language, operators on languages (union, intersection, concatenation, Kleene closure);
- Deterministic finite state automata, regular languages, regular expressions;
- Syntax diagrams, EBNF notation, derivation, terminal and non-terminal symbols;
- Lexical/syntactic/semantic analysis, language interpretation, recursive descent algorithm, arithmetic expression analysis;
- Formal program properties, program proofs, assertions, invariants, pre/post conditions, JML, propositional and temporal logic;
- Turing machines, undecidable problems, classes P, NP, and NP-complete.

2.1.3 Physics SIAM – 4 ECTS – Swiss grade 4.4/6

Physique SIAM in french given by Ales Janka

Kinematics:

- Speed: constant; instantaneous - derivative; average; relative motion
- Acceleration: medium; instantaneous
- Free fall and oblique jet
- MRU and MRUA

Forces:

- 3 Newton's laws: law of inertia; force, mass, quantity of motion; action-reaction.
- Force Dynamics
- Gravitational force

Energy:

- Notion of work
- Power
- Mechanical energy: kinetic, potential

Oscillations, waves:

- Notion of electromagnetic wave
- Frequency
- Phase
- Light, sound; speed of propagation

Electricity (learning reminders):

- Ohm's law; power; basic circuits; parallel and series resistors

Possibly:

- Solids Statics
- Fluids: Archimedes, Pascal

2.1.4 Statistics – 1.5 ECTS – Swiss grade 4.5/6

Statistiques in german given by Christophe Hebeisen

Course content included:

- Descriptive statistics: applications, random data processing, extraction of characteristic values (mean, variance, standard deviation, correlation coefficient), extraction by simulation.
- Probabilities: definitions, algebra of events, combinatorial analysis (permutations, arrangements, combinations, with or without repetitions), probability calculus (definitions, conditional proba.), random variables (definitions, discrete and continuous variables, distribution functions, mathematical expectation, variance), fundamental laws (binomial, geometric, Poisson's, exponential, hypergeometric, normal).
- Error calculation (confidence interval).
- Linear regression (matrix approach) and/or introduction to hypothesis testing.

2.2 Project and Project Management – 6 ECTS

2.2.1 Project Management ICT – 2 ECTS – Swiss grade 5.2/6

Projektmanagement ICT in german given by Andreas Fischer

Project Management Fundamentals:

- Organizational Structure
- Stress Triangle
- Other basic concepts

Project lifecycle - customer-oriented vision:

- 5-phase approach - overview
- Phase 1 - strategy: why carry out this project, what to achieve in this project, choice among alternatives
- Phase 2 - tactics: how to carry out this project, detailed needs analysis, propose planning, draft specifications
- Phase 3 - Execution: overseeing the execution of a project across the product life cycle (see Section 3)
- Phase 4 - production start-up: actions before/during/after production start-up
- Phase 5 - Project Closure and Evaluation: What does it mean to close a project?

Product lifecycle - team-oriented development vision:

- 4-phase approach - overview: why 2 life cycles, phase sequencing (cascade), iterations on phases (agility)
- Phase 1 - analysis: what are the expected results, external view of the product, backlog approach of functionalities, listing of product properties and constraints
- Phase 2 - design: how to realize the functionalities, internal view of the product, architecture, use of modeling languages (BPMN, UML)
- Phase 3 - implementation
- Phase 4 - tests

Roles in Project Management:

- Roles related to the project life cycle
- Roles related to the product life cycle: traditional roles, agile roles

Tools:

- Session management: agenda, minutes
- Planning: Gantt, task estimation techniques, Work Breakdown Structure, WP approach, deliverables and milestones
- Reporting: writing techniques, document structure

2.2.2 Semester Project – 2.5 ECTS – Swiss grade 5.7/6

Projet de semestre in french given by Frédéric Bapst, Sandy Ingram and François Kilchoer

For the semester project, teachers form groups of 3-6 people. The project generally involves the computer production of a game (e.g. card games, dots-and-boxes, naval battle...). All groups follow a common specification, which allows the modules to be exchanged and the results to be compared (e.g. the strategies of the automatic player). The subject allows developing playful, creative and competitive aspects. In addition to the two periods scheduled weekly, there are at least two other work periods taken from the student's free time.

2.3 Algorithmic, Database, Software Engineering – 17 ECTS

2.3.1 Data Structures and Algorithms 2 & Labs – 3.5 ECTS – Swiss grade 5.5/6

Algorithmique et structures de données 2 in french given by Frédéric Bapst

Course content included:

- Damped complexity, expected complexity.
- Arbre, parcours, heap, skew-heap, arbre de fouille (binary search tree), arbres-splay, treap, B-arbres.
- Disjoint sets, discrete simulation, string searching, editing distance, compression (Huffman, LempelZiv)
- Pseudo-pointers, generality, some clever algorithms, tests and programmer's tools

2.3.2 Data Structures and Algorithms 3 & Labs – 5.5 ECTS – Swiss grade 5/6

Algorithmique et structures de données 3 in french given by Frédéric Bapst

Course content included:

- Graph, path, shortest path algorithms, flows and breaks in a network, connectivity, overlay tree, topological sorting. Some other concepts (click, matching, coloring, bipartite, condensation...).
- Backtracking, alpha/beta
- Computational geometry: primitives, direction of rotation, scanning technique, points in a polygon, polygon map, RangeTree, IntervalTree, duality, clustering.
- Code optimization. Java bytecode (concepts and tools)

2.3.3 Software Engineering 1 – 4 ECTS – Swiss grade 5.4/6

Génie Logiciel 1 in french given by Pierre Kuonen and Elena Mugellini

Course content included:

- Software Engineering Motivation
- Principle of object-oriented modeling
- Main UML diagrams
- Using a tool for modeling with UML

2.3.4 Databases 1 – 4 ECTS – Swiss grade 5.3/6

Bases de données 1 in french given by Houda Chabbi

Course content included:

- General introduction to DBMS.
- Functions of a database management system (logical and physical independence, data consistency, data sharability, non-redundancy of data, data security, efficiency of data access).
- Entity-association data model.
- Relational model and relational algebra
- Transition from the entity-association model to the relational model.
- Language for defining, manipulating and controlling SQL data.
- Extended SQL: trigger, stored procedure
- Dynamic SQL.
- Understanding and avoiding SQL injection

2.4 Information Systems and Mobile Applications – 14 ECTS

2.4.1 Information Systems 1 – 2 ECTS – Swiss grade 5/6

Systèmes d'information 1 in french given by Elena Mugellini

Document modeling & representing:

- Document Model
- XML Language (syntax, tag)
- DTD (Document Type Definition)
- XML Schema - basic concepts

Transforming Document:

- XPATH Language
- XSLT Language

Document Rendering:

- CSS (Cascading Style Sheet)
- XSL-FO (Formatting Object) Language
- SVG (Scalable Vector Graphics), SMIL (Synchronized Multimedia Integration Language), etc.

Programming Document:

- DOM (Document Object Model) standard
- SAX (Simple API for XML) standard
- JDOM (Java API for DOM), JAXP (Java API for XML Processing)

2.4.2 Concurrent Programming 1 – 4 ECTS – Swiss grade 5.2/6

Programmation concurrente 1 in french given by François Kilchoer

Course content included:

- Introduction: first approach, definitions, characteristics and model.
- Mutual exclusion: problems, implementation (active waiting, locks).
- Synchronization: problems, realization (semaphores, monitors)
- Development languages/environments that support multiple processes: JR, Java, pthreads, etc.

2.4.3 Concurrent Programming 2 – 4 ECTS – Swiss grade 5.1/6

Programmation concurrente 2 in french given by François Kilchoer

Course content included:

- Introduction: first approach, definitions, characteristics and model.
- Communication: issues, implementation (asynchronous and synchronous messages, appointments, CPR and RMI)
- Development languages/environments that support distributed programming: JR, Java, etc.
- Distributed programming.
- Parallel programming.

2.4.4 Mobile Applications 1 – 4 ECTS – Swiss grade 5.1/6

Applications Mobiles 1 in french given by Pascal Bruegger

Through this course the student will become familiar with Android mobile concepts: Major chapters:

- Study of the SDK and the components of the development platform.
- Study of the main components: Activity and service, Intent and broadcast receiver, Fragment, Persistence and Content Provider
- Programming of applications as Labs
- Application deployment on smartphone and tablet

2.5 Embedded systems and operating systems – 11 ECTS

2.5.1 Embedded-Systems 1 – 4 ECTS – Swiss grade 5.1/6

Embedded-Systems 1 in german given by Jacques Supcik

The course will cover the following topics:

- The C language and its use (basic types and declarations, complex types, functions, pointers and function pointers)
- Object-oriented programming in C
- Development tools (generation, validation, documentation)
- ARM microprocessor instruction set (assembler)
- ARM microprocessor addressing modes
- Assembler Interface - C
- Floating point and integer processing
- Implementation of simple peripherals

2.5.2 Operating Systems 1 – 3 ECTS – Swiss grade 5.1/6

Système d'exploitation 1 in french given by François Kilchoer

Course content included:

- Memory, organization and management: main memory, virtual memory, management algorithms.
- Scheduling algorithms - basic mechanisms and examples
- Disk, organization and management: performance optimization, file management systems, security, Unix/NT examples, protection and backup.
- Input-output: basic mechanisms, Unix/NT examples.
- Computer tools/shell programming: sh and main variants; common commands (coreutils) + some tools for experts (grep, sed, awk, python).

2.5.3 Embedded-Systems 2 – 4 ECTS – Swiss grade 5/6

Systèmes Embarqués 2 in french given by Jacques Supcik

The course will cover the following topics:

- General microprocessor architecture (Von Neuman, Harvard, SIMD, MIMD)
- Internal microprocessor architecture
- Programmation interruptive
- Interconnection of common peripherals
- Operating system kernel elements (thread, semaphore, etc.)
- Direct Memory Access (DMA)
- Hidden memories
- Memory Management Unit (MMU)

3 3^{rd} year

3.1 Advanced Computer Science – 8 ECTS

3.1.1 Elective: Game Design and Development – 2 ECTS – Swiss grade 5.5/6

Chapitre spécialisé: Game Design and Development in french given by Maurizio Rigamonti and Maurizio Caon

The course consists of a theoretical part and a practical part (directed work with a tutorial to learn how to use Unity and to make a video game prototype). The theoretical part includes:

- Introduction to video game design: presentation and explanation of design methods, collaboration in a multidisciplinary team and interaction with end users.
- Presentation and explanations of formal elements, with focus on game mechanics (e.g. game rules, definition of actions, how to manage the user experience, etc.) and their balancing, interface structure and interaction modalities.
- Presentation of dramatic elements such as story, scenarios, characters and graphic styles.
- Introduction to 'Gamification' and 'Serious Game' practices.
- Introduction to starting a business, industry business models, and fundraising. Presentation of career opportunities in the field.

The practical teaching will be divided into two parts: a tutorial on how Unity works and a project done by groups of 2 or 3 students. The project will consist in imagining, designing and developing a video game without constraints of the technologies to be used (students will have at their disposal several peripherals to be used for the development of the interface of the video game, for example: Microsoft Kinect, Wii remote controller, Oculus Rift et cetera).

3.1.2 Elective: NoSQL – 2 ECTS – Swiss grade 5.1/6

Chapitre spécialisé: Introduction au monde NoSQL in french given by Houda Chabbi and Benoit Perroud

Since about ten years the NoSQL and bigdata movement has been growing more and more. Initially presented as the magical alternative to the immutable RDBMSs, the current trend is moderating these words to insist on the complementarity of all these technologies with each other. The future, in terms of data storage, will therefore take the form of "polyglot persistence". For designers and developers of new information systems, it is therefore a question of being able to set up an architecture that mixes all these technologies to good effect. To do this, this chapter proposes to understand what these technologies known as NoSQL are, to see their advantages and disadvantages in order to allow a judicious use of them. The following concepts will be discussed:

- Scale-out vs. scale-in and BASE vs. ACID properties
- Distributed storage and distributed computing (HDFS, Map Reduce, TEZ, Spark...)
- Key-value warehouses with the following demo tool: Redis
- The document-oriented databases with as demonstration tool: MongoDB
- Column oriented databases with Cassandra as demonstration tool
- Graph oriented databases with Neo4j as a demonstration tool.

3.1.3 Elective: Macine Learning – 2 ECTS – Swiss grade 4.9/6

Chapitre spécialisé: Machine Learning Applications in french given by Elena Mugellini and Jean Hennebert

Introduction:

- Machine Learning is a branch of Artificial Intelligence that studies so-called machine learning algorithms. These algorithms are capable, using examples, of solving complex problems that would be difficult to solve using traditional approaches. Machine Learning is used today in several fields: prediction (stock market evolution, weather), classification (gesture recognition, speech recognition, image recognition), verification/detection (biometric authentication), data mining (clustering on complex data).

Method:

- The course combines theoretical and practical sessions. Of particular importance is given to practical sessions, which will be done through guided classroom exercises (including the use of the KNIME and WEKA tools) and through mini-projects carried out in groups of 2-3 people.

Part I - Basic principles (20%):

- Definition of Machine Learning approaches: concepts of learning from data, supervised vs. unsupervised learning, feature extraction, hypothesis presentation.
- Definition of fields of use through concrete examples: prediction, classification, verification, clustering.

Part II - Machine learning algorithms: theory and applications (60%):

- Introduction au framework KNIME
- Raw data to useful features: preprocessing algorithms and feature extraction
- Clustering
- Rules of association
- Approches Bayesiennes
- Decision trees
- Artificial neural networks
- Gaussian Mixtures

Part III - Advanced applications (20%):

- Time signal processing
- State-based modeling
- Heterogeneous data processing, merging principles

3.1.4 Elective: IT startup bootcamp – 2 ECTS – Swiss grade 5.5/6

Chapitre spécialisé: IT startup bootcamp in french given by Omar Abou Khaled and Jean Hennebert

Course content included:

- Innovation and entrepreneurship / Developing an opportunity (ideation, pitch, etc.)
- Business concept & models in IT / Business model canvas / Lean canvas
- Lean startup development / Minimum Viable Products / IT product roadmap
- Start-ups ecosystems including coaching, funding, etc.
- Intellectual property elements in an IT startup context
- Team (building your team, etc.) / market opportunity (go-to-market)
- Finance (broad lines) / Approaches to financing start-ups: crowdfunding- angels-VC, valuation, NPV

3.2 Advanced Computer Science 2 – 10 ECTS

3.2.1 Human-Computer Interaction 2 – 2 ECTS – Swiss grade 5.1/6

Interfaces homme-machine 2 in french given by Sandy Ingram

Main content (technical and ergonomic aspects):

- Principles and techniques of User-Centered Design (UCD).
- Main components of UX (user experience): utility, usability, and emotional impact.
- Application of classical engineering techniques in the development cycle of user interfaces and interactive systems.
- Methods and techniques specific to each phase of the development cycle (e.g., ideation, affinity diagram, personas, wireframe, interactive mockup).
- Ergonomic principles and criteria for the development of 'usable' interfaces.
- Introduction to 'Material Design' (its link with ergonomic criteria, its advantages over flat design).
- Introduction to the FLUX interface design pattern (specificities, advantages, links with other design patterns and MVC variants).
- Introduction to the REACT library (based on FLUX and used in the development of front-end user interfaces).
- Types of user interface evaluation (summative vs. formative, empirical vs. analytical, based on qualitative vs. quantitative data, rapid vs. rigorous).
- Standard questionnaires used in empirical evaluations.
- Adaptation of the evaluation to the development phase and context of the project.

Optional content (depending on the chosen themes and the time available):

- Introduction to the REDUX bookstore.

3.2.2 Databases 2 – 2 ECTS – Swiss grade 4.6/6

Bases de données 2 in french given by Houda Chabbi

Course content included:

- Know advanced SQL LMD: advanced grouping functions / windowing, etc.
- Functional dependency and standardization
- Physical organization: (access methods, indexing)
- Concurrency management: transaction, locking algorithms and stamping serialization levels.
- Fail-safe and data security: backup, logging recovery...
- Query optimization mechanism

3.2.3 Software Engineering 2 – 3 ECTS – Swiss grade 5/6

Génie logiciel 2 in french given by Pierre Kuonen

Course content included:

- OO architecture principles: Component and deployment diagrams.
- Main design patterns
- Principles of 3-tier architecture
- Software components: Design and implementation of a client/server system.

3.2.4 Logic Programming – 3 ECTS – Swiss grade 5.4/6

Programmation logique in french given by Frédéric Bapst

Logic programming (64 periods):

- Basics of Prolog: logic, predicates, logic variable, bypass trees.
- Incomplete data structures.
- Browse through report networks.
- Cutaneous problems, negative. Dynamic rules (assert).
- Definite Clause Grammars, use of Prolog for syntax analysis.
- Meta-programming. Notions of blackboards.
- Extension of the logic model by the expression of constraints.
- Propagation/distribution, constraint programming techniques, GnuProlog engine
- Programmation multi langages

3.3 Applied Computer Science 1 – 9 ECTS

3.3.1 Physics and Simulation – 3 ECTS – Swiss grade 5.4/6

Physique et simulation in french given by Ales Janka

Physics: a reminder of the concepts necessary for the modeling/simulation of the mechanics of rigid and deformable bodies:

- Kinematics
- Amount of motion, force balance, energy conservation
- Friction, contact
- Mass-spring system, harmonic oscillator, wave equation
- Barycenter, Archimedes's law

Mathematics: numerical processing of ordinary differential equations:

- Explicit, implicit and symplectic numerical schemes for the Cauchy problem and their properties (stability, precision, energy conservation, ...)
- Finite difference method
- Iterative resolution of linear and non-linear systems

3.3.2 Web Application Security – 2 ECTS – Swiss grade 4.6/6

Sécurité des applications in french given by Rudolf Scheurer

Course content included:

- Institutions and their activities (e.g. OWASP, WASC, SANS, MITRE)
- Fault list (e.g. OWASP Top10, WITHOUT Top25)
- Vulnerability database (e.g. CVE, CWE)
- Methods and metrics for risk assessment of vulnerabilities
- Integration of security in the development cycle (e.g. Threat Modeling)
- Study and treatment of the most frequent / dangerous faults (OWASP Top10)

3.4 Information Systems Specialization – 12 ECTS

3.4.1 Advanced Java Programming – 2 ECTS – Swiss grade 5/6

Programmation avancée Java in french given by Rudolf Scheurer

Advanced programming in Java:

- Basic mechanisms of network communication in Java: Sockets
- Interfacing to native software components: JNI (Java Native Interface)
- Abstraction layer for remote method invocation: RMI (Remote Method Invocation)
- Remote application management with JMX (Java Management eXtension)

3.4.2 Information Systems Architecture – 7 ECTS – Swiss grade 5.2/6

Architecture des systèmes d'information in french given by Omar Abou Khaled, Houda Chabbi and Pierre Kuonen

This is an Integrated Project (IP) carried out as a group to acquire IS project management skills and to train the following technical skills:

- Apply the theory introduced in Software Engineering 1 and 2.
- Apply the theory introduced in Information Systems 1 and 2.
- Installation and use of a development framework (Java EE, .NET, etc.)
- Installation, configuration and use of an integrated development environment (VS 2008, Eclipse, etc.).
- Apply the theory introduced in databases 1 and 2.
- Attack a DBMS through an application via JDBC or ADO.
- Establish the physical implementation of a database by justifying the chosen optimizations.
- Managing XML in a database.
- Use of management tools for: logging, testing, modeling, licensing, deployment and code documentation.

3.4.3 Information Systems 2 – 3 ECTS – Swiss grade 5.8/6

Systèmes d'information 2 in french given by Omar Abou Khaled and Elena Mugellini

Course content included:

- Information system (Definition, principles, models, installation and configuration, access protocols, comparison, etc.).
- Protocols and languages: HTTP, MIMETYPE, URI, XHTML, CSS.
- Advanced XML schema modeling techniques.
- Client/server architectures: 2-tier, 3-tier, n-tier and SOA (Services Oriented Architecture) architectures.
- Frameworks, application servers and development platforms.
- The .NET platform: introduction and operating principle.
- NET platform: ASP.NET and ADO.NET.
- The Java EE platform: introduction and operating principles.
- Java EE: servlets, JSP and JSF.
- Overview of the PhP and Ruby on Rails platforms.
- Web Services: principles and protocols (UDDI, WSDL, SOAP).
- XML databases.
- RIA (Rich Internet Application) - AJAX - declarative interfaces (XAML, XUL, etc.).
- Directories and meta-directories.

3.5 Semester Projects – 9 ECTS

3.5.1 Semester Project 5 – 4 ECTS – Swiss grade 4.8/6

Semesterprojekt 5 in german given by Daniel Gachet and Rudolf Scheurer

Course content included:

- Individual or pair projects usually proposed by an external partner (industry, service company, academic institute).

3.5.2 Semester Project 6 – 5 ECTS – Swiss grade 5.3/6

Semesterprojekt 6 in german given by Omar Abou Khaled and Elena Mugellini

Course content included:

- Individual or two projects that last two blocks, usually proposed by an external partner (industry, service company, academic institute).

3.6 Bachelor Thesis – 12 ECTS

3.6.1 Bachelor Thesis – 12 ECTS – Swiss grade 4.9/6

Travail de Bachelor in english given by Sandy Ingram and Houda Chabbi

Course content included:

- Individual projects relating to ICT professions validated by the college of experts. These projects are usually proposed by an external partner (industry, service company, university institute).