Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Computer Sciences Engineering (cód. 702)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13186L	Human-Computer Interaction	*** TRANSLATE ME: ***	6	Semester	156
INF13175L	Programming I	*** TRANSLATE ME: ***	6	Semester	156
INF13177L	Digital Systems	*** TRANSLATE ME: ***	6	Semester	156
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT12877L	Mathematical Calculus I	*** TRANSLATE ME: ***	6	Semester	156

***** TRANSLATE ME:UC de Recuperação no 1º Ano do 2º Semestre *****

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT12878L	* Mathematical Calculus II	*** TRANSLATE ME: ***	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13187L	Computer Architecture I	*** TRANSLATE ME: ***	6	Semester	156
INF13188L	Data Structures and Algorithms I	*** TRANSLATE ME: ***	6	Semester	156
FIS13008L	General Physics I	*** TRANSLATE ME: ***	6	Semester	156
MAT12878L	Mathematical Calculus II	*** TRANSLATE ME: ***	6	Semester	156
MAT12619L	Introduction to Probability and Statistics	Mathematics	6	Semester	156

***** TRANSLATE ME:UC de Recuperação no 1º Ano do 1º Semestre *****

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT12877L	* Mathematical Calculus I	*** TRANSLATE ME: ***	6	Semester	156
MAT0900L	* Linear Algebra and Geometry I	Mathematics	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13189L	Computer Architecture II	*** TRANSLATE ME: ***	6	Semester	156
INF13190L	Databases	*** TRANSLATE ME: ***	6	Semester	156
INF13192L	Computer Graphics	*** TRANSLATE ME: ***	6	Semester	156
INF13194L	Programming II	*** TRANSLATE ME: ***	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0932L	Discrete Mathematics	Mathematics	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13195L	Automata and Programming Languages	*** TRANSLATE ME: ***	6	Semester	156
INF13196L	Data Structures and Algorithms II	*** TRANSLATE ME: ***	6	Semester	156
INF13199L	Introduction to Research	*** TRANSLATE ME: ***	3	Semester	78
INF13200L	Logic and Computation	*** TRANSLATE ME: ***	3	Semester	78
INF13201L	Computer Networks	*** TRANSLATE ME: ***	6	Semester	156
INF13202L	Operative systems	*** TRANSLATE ME: ***	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13203L	Machine Learning	*** TRANSLATE ME: ***	6	Semester	156
INF13204L	Methods and Software Development	*** TRANSLATE ME: ***	6	Semester	156
INF13205L	Programming III	*** TRANSLATE ME: ***	6	Semester	156
INF13206L	Distributed Systems	*** TRANSLATE ME: ***	6	Semester	156
INF13207L	Web Technologies	*** TRANSLATE ME: ***	6	Semester	156

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13208L	Artificial Intelligence	*** TRANSLATE ME: ***	6	Semester	156
INF13212L	Internship/Project	*** TRANSLATE ME: ***	12	Semester	312
GES2310L	Entrepreneurship and Innovation	Management	6	Semester	156

Group of Options

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13213L	Compilers	*** TRANSLATE ME: ***	6	Semester	156
INF13209L	Integration and Analytical Processing of Information	*** TRANSLATE ME: ***	3	Semester	78
INF13210L	Security	*** TRANSLATE ME: ***	3	Semester	78
INF13211L	Mobile Systems and Applications	*** TRANSLATE ME: ***	3	Semester	78

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para obtenção do grau de licenciado em Engenharia Informática é necessário obter aprovação a 174 ECTS em unidades de curriculares obrigatórias e 6 ECTS em unidades curriculares optativas distribuídas da seguinte forma:

1º Ano

1º Semestre:

5 UC Obrigatórias num total de 30 ECTS

2º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre

5 UC Obrigatórias num total de 30 ECTS

4º Semestre

6 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

5 UC Obrigatórias num total de 30 ECTS

6º Semestre

3 UC Obrigatórias num total de 24 ECTS

UC Optativa num total de 6 ECTS do Grupo de Optativas disponivel ***

Program Contents

Back

Human-Computer Interaction (INF13186L)

I- Fundamentals:

1. The Human; The computer; The interaction
2. Interaction Paradigms
3. Interaction Styles
4. User and Task Analysis

II. Interaction Design basics

1. Usability engineering
2. Principles that support usability
3. Golden rules and heuristics
4. Iterative design and the spiral model
5. Prototyping
6. Evaluation techniques (Heuristic and Predictive)

Back

Programming I (INF13175L)

Notion of algorithm and instruction
Edit, compile, and debug process
IDEs and pseudo-code
Notion of constant and variable
Arithmetic and Expressions
Basic types: integer, real, boolean, string
Instruction and assignment
Decision structures: comparison, multiple alternatives, nested branches
Repetition structures: while, for, sentinel values, nested loops
Functions: parameters and return value
Scope of variables and function reuse
One and two-dimensional arrays
Structures
Sequential Access Files
Recursion

Back

Digital Systems (INF13177L)

- Numbering systems, numerical codes and arithmetic operations

- Boolean algebra
– Logic functions: AND, OR, NOT. Morgan Laws
– Canonical form (sum of products of sums and products)
– Algebraic simplification of logic functions
– Karnaugh Maps
– Logic functions: XOR, NAND and NOR
– Synthesis of functions by the method of bridging

- Combinatorial circuits
– Half-adder circuits, adder, subtractor, comparator, multiplexer, demultiplexer, priority encoder, decoder

- Synthesis of combinatorial circuits
– Introduction to sequential circuits
– Flip-flops: SR, D, JK, T

- Synthesis of simple sequential circuits
– Moore and Mealy machines

Back

Linear Algebra and Geometry I (MAT0900L)

Systems of linear equations.
Matrices.
Determinants.
Vector spaces.
Linear applications.
Eigenvalues and eigenvectors.
Geometry of plane and space.
Quadratic forms.

Back

Mathematical Calculus I (MAT12877L)

1. Sequences and series.
2. Real functions of one variable.
3. Differential calculus.
4. Sequences and series of functions.
5. Integral calculus and applications.

Back

Mathematical Calculus II (MAT12878L)

1. Differential Calculus in Rn

Algebraic and topological structure of Rn. Functions from Rn to Rm: Continuity and the notion of limit. Differentiability. Partial derivatives. Chain rule. Taylor's theorem in Rn and applications to the study of extreme values. Inverse and implicit function theorems. Extreme values of functions with constrained variables

2. Integral Calculus in Rn

Multiple integrals: Fubini's theorem, change of variables theorem, applications to the computation of physical quantities. Line integrals: Integrals of scalar fields and vector fields. Fundamental theorem of calculus for line integrals, conservative fields and scalar potentials. Green's theorem. Surface integrals: surface integrals of a scalar field, flux of a vector field, divergence theorem and Stokes' theorem.

Back

Computer Architecture I (INF13187L)

- Introduction to the Von Neumann architecture (stored program computer).
- Memory organization. Notions of byte and address.
- Simplified version of an instruction execution cycle (fetch, decode, execute). The role of the Program Counter register.
- Introduction to the MIPS microprocessor: registers, assembly instructions, adressing modes. Bytes, words and endianness. Machine code.
- Program organization. Simplified version of an ABI (register usage conventions, function calls, argument passing and return, stack, memory allocation).
- Exceptions. Interrupts and syscalls. Processor execution modes user and kernel.
- Floating point number representations IEEE754. Numerical issues.
- Brief introduction to software security issues (buffer overflows and exploits).

Back

Data Structures and Algorithms I (INF13188L)

I- Introduction to algorithm's analysis: Spatial and Temporal Complexity; Best case, worst case and expected case; Notations Big-O, Omega and Theta; Analysis of iterative and recursive algorithms

II- Abstract data types:

1. Lists, Stacks and Queues Trees
2. Binary trees: binary trees traversals; Binary search trees; Balanced trees; AVL Trees.

III- Priority queues: binary heaps, construction of a heap from a vector

IV- Hashing: Hash function; Separate chaining; Collision resolution strategies: Linear probing, Quadratic probing and Double Hashing; Rehashing

V- The sorting problem: Presentation, analysis and comparison of the behaviour of some sorting algorithms: BubbleSort, Insertion sort, Mergesort, Heapsort, Quicksort, Bucketsort

Back

General Physics I (FIS13008L)

I. Mechanics
- Scientific method. Measurements, units and dimensions.
- Kinematics and dynamics of mass points. Newton's laws and applications.
- Work and energy. Collisions and momentum. Conservation laws.
- Systems of many particles. The rigid body. Angular momentum.
- Universal gravitation.

II. Oscillations and waves
- Periodic and simple harmonic motion. Forced oscillations and resonance.
- Coupled oscillators. Normal modes.
- Progressive waves. The Doppler effect.
- Superposition and interference. Standing waves.

III. Option

A.Thermodynamics
- Thermal equilibrium and temperature.
- The ideal gas. The equation of state. Internal energy, heat and work.
- Calorimetry. Work and heat in thermal processes.
- The kinetic theory of gases.
- The 2nd law of thermodynamics. Heat engines. Reversible and irreversible processes. Entropy.

B.Topics on mechanical properties of solids
- Stress, deformation, elasticity and Hooke's law.
- Microscopic model for mechanical constant of solids.

Back

Introduction to Probability and Statistics (MAT12619L)

Theoretical Component

What is Statistics and its role in scientific work; population, sample. Probability: definitions, axiomatic and properties, conditional probability, Bayes' theorem; discrete models: uniform in n points, binomial, Poisson, geometric and hypergeometric; continuous models: uniform, exponential, normal, t-Student, chi-square; discrete random pair; central limit theorem. Descriptive statistics: graphical representation of data, sample characteristics. Statistical Inference: estimation by confidence intervals (for mean value, variance and difference of mean values of normal populations); hypothesis tests: on the mean value in normal populations and with large samples (t-tests); on variance in normal populations; adjustment; on the mean value based on small samples and on non-normal populations (Wilcoxon and signal test); for comparison of two populations, based on two independent samples and two paired samples (t-tests, Mann-Whitney, Wilcoxon's and signs). Simple Linear Regression.

Practical Component

Resolution of exercises involving the theory exposed in the theoretical classes and using the programs, whenever possible, SPSS or R. These exercises are chosen so as to illustrate the best possible the application of statistics in the area of Engineering and Industrial Management

Back

Computer Architecture II (INF13189L)

Organisation of computer systems. Performance analysis. Microprocessor implementation. Control and datapath: single-cycle datapath, pipelining; instruction-level parallelism; out-of-order execution. Multicore processors and multiprocessors. Memory hierarchies. Cache memory theory and operation: cache principles; organisation; consistency and coherence; performance analysis. Virtual memory: principles; implementation; performance analysis.

Back

Databases (INF13190L)

Introduction: Management System Database, Data Model, Databases Languages.

Entity Relationship Model (ER): Basic concepts (entity and relationship); Design of ER Model; mapping constraints; Keys, ER Diagram, Weak Entities; Extensions to the ER model; Reduction of an Model ER to table schema.

Relational Model: Structure of Relational Databases, Relational Algebra (operators), Relational Algebra Extensions. Modification of the Database.

Languages for database manipulation (SQL): Basic structure and set of SQL operations, Aggregate Functions, Modification of the database and views, Data Definition Language (DDL).

Database Integrity: Domain Restrictions, referential integrity, assertions and triggers, functional dependencies.

Database Normalization: Functional dependencies, Boyce-Codd normal form and 3rd normal form.

Back

Computer Graphics (INF13192L)

1. Fundamental Concepts
Applications; Digitization and Media Formats; Animation as a sequence of still images; Standard Graphics Libraries.

2. Rendering
Rendering in Nature; Polygonal Representation; Scene Graphs and the Graphics Pipeline; Transformation Systems.

3. Geometric Modeling
Basic geometric operations; Curve Approximation Techniques; Surface Representation; Procedural Models; Constructive Solid Geometry.

4. Animation and Interaction
Forward and Inverse Kinematics; Collision Detection and Response; Key-Frame Animation; Physics Based Motions.

Back

Programming II (INF13194L)

Object-oriented analysis and program design.
A general-purpose object-oriented language (Java).
Incremental program development.
Class libraries (packages).
Simple graphical user interfaces.

Back

Discrete Mathematics (MAT0932L)

Sets
Induction
Combinatorics and counting
Recurrence
Graphs
Euclid algorithm
Modular arithmetic

Back

Automata and Programming Languages (INF13195L)

1. Words, Languages and Expressions
Alphabets, Words and Languages, Regular Expressions
2. Finite automata
Deterministic Finite Automata, Non-deterministic computing, Elimination of Non-Determinism, Minimization and Composition of DFA, The Pumping Lemma
3. Grammars and Push-down Automata
4. Syntax analisys
Syntactic Analysis and Clean Grammars, LL(k) and LR(k) Grammars
5. Representation and Execution of Programs, Abstract Syntax Tree, Semantic Analysis, Table of symbols, Name Analysis, Type systems, Checking and Inference Types, Support for a Interpreter

Back

Data Structures and Algorithms II (INF13196L)

Time and space complexity analysis: Amortized complexity analysis.
Algorithm design: Divide and conquer algorithms; Greedy algorithms; Dynamic programming.
Graphs: Directed and undirected graphs, weighted graphs; Adjacency-list and adjacency-matrix representations; Breadth-first and depth-first search; Topological sort; Connected and strongly connected components; Minimum spanning tree: Prim and Kruskal algorithms; The union-find abstract data type; Shortest paths: Bellman-Ford, Dijkstra and DAG's algorithms; All-pairs shortest paths: the Floyd-Warshall algorithm; Network flows.
Complexity theory: The P and NP classes; Problem reduction.

Back

Introduction to Research (INF13199L)

1. Research and writing of scientific and academic works
2. References analysis
2.1. Why use sources
2.2. Search
2.3. Evaluating
2.4 Integration of multiple sources
2.5 Main standards in references management
3. Sections of scientific and academic works
3.1. Acknowledgments
3.2. Abstract
3.3. Introduction
3.4. Methods
3.5. Results
3.6. Discussion / Conclusions
3.7 References
3.8 Attachments
4. Avoid and control plagiarism
4.1. Forms of plagiarism
4.2. Case studies
4.3. References standards application
5. Models and examples of research projects
5.1 Case studies
5.2 Elaboration of project proposals

Back

Logic and Computation (INF13200L)

1. Propositional Calculus
1.1 Syntax: Connectives, Well-formed formulas
1.2 Semantic: Truth tables, True and Valid Formulas, Normal Forms, Inference Rules
2. Predicate Calculus
2.1 Limits of Propositional Calculus
2.2 Quantification and Proofs: Informal Reasoning, Universal e Existential Quantifiers, Refutation by Counter-Example, Direct Proof, Proof by Contradiction
3. Recursion
3.1 Recursive Definitions: Recursive Terms, Recursive Relations and Functions
3.2 Inductive Proofs: Induction in the Natural Numbers, Structural Induction

Back

Computer Networks (INF13201L)

Main Topics:
1 Layered communication architectures (OSI and TCP/IP).
2 Physical Layer - Transmission media, modulation, and bandwidth,
3 Data Link Layer - Error correction, error detection, and flow control,
4 Medium Access Control sublayer - Ethernet, hubs and switches
5 Network layer
routing - algorithms, routing in the Internet, RIP, OSPF, BGP,
IP addressing - IPv4, IPv6, DHCP, NAT
6 Transport layer - UDP, TCP, flow and congestion control
7 Network services: Address assignment (DHCP), Address resolution (ARP), Domain name DNS
8 Security: Cryptography, SSL, IPsec, WEP, firewalls

Practical topics:
1 LAN setup
2 Basic Network setup on Linux
3 Router/DHCP Basic Configuration
4 Socket programming

Back

Operative systems (INF13202L)

Main Topics:
Main tasks of an operating system
Operating system architecture and organization
Dual Mode operation
Multi-processing, concurrency and parallelism
Processes and threads
Scheduling
Memory management
Virtualization
File systems
Redundancy and RAID systems

Project topics:
Processes and thread creation
Scheduling algorithms
Memory allocation algorithms
Indexed file system
Interprocess communication

Back

Machine Learning (INF13203L)

Basic concepts
Machine Learning paradigms: supervised, unsupervised, re-inforcement learning
Supervised learning: classification and regression
Binary, multi-class and multi-label classification
Algorithms: logistic regression, perceptron, decision trees, rules, naive Bayes, support vector machines
ML practice: overfitting, bias/variance tradeoff, model selection (train/test, holdout, cross-validation), confusion matrix and evaluation metrics (accuracy, error, precision, recall, others)
Unsupervised learning: clustering
Algorithms: K-means, EM
Clustering evaluation measures
Introduction to ensemble methods

Back

Methods and Software Development (INF13204L)

- Introduction to Software Engineering
- Software Development Processes
- Plan based methods
- Agile methods

- Requirements engineering
– Functional, non-functional, system and user requirements
– Requirements validation
– Requirements management

- Software modeling
– Context, interaction, structural and behavior models
– Software development based in models

- Design and implementation of software
– Software design using UML
– Software patterns
– Software implementation

- Configuration management
– Change, version and release management
– System build

- Software verification and validation
– Development, release and user testing

Back

Programming III (INF13205L)

Logic programming languages.
Functional programming languages.
Constraint programming and related modeling languages.
Streaming languages.

Back

Distributed Systems (INF13206L)

Introduction to Distributed Systems (DS)
- concepts, examples, characteristics

Models of Interaction and Communication in DS
- Centralized, decentralized, hybrid architectures
- Multi-layer protocols, RPC, Multicast
- Marshalling
- Middleware

Distributed Objects and Remote Invocation
- Java RMI, CORBA
- Marshalling Case studies: RPC, Java RMI, SOAP, REST

Web Services and REST

Distributed File Systems

Name Services

Synchronization and distributed coordination
- Clock Synchronization
- Mutual Exclusion in Distributed Context
- Algorithms for election

Replication

Fault Tolerance

Cloud Computing

Data-Intensive Computing, Map-Reduce Paradigm

Back

Web Technologies (INF13207L)

Introduction
- concepts, origin and Web historical perspective
- infrastructure, content hosting

Web Programming
- Requirements analysis
- client side, server side
- Application Servers
- Languages, Frameworks, WebContainers and WebApp deployment
- MVC Model
- Usability
- Multiplatform Development
- Progressive Web Apps

Security in Web Applications
- client, server and network risk analysis
- study of common vulnerabilities
- protection mechanisms for authentication and confidentiality

Quality
- Standards and good practice
- Metrics for quality of service
- Tools for evaluating the quality of service

Back

Artificial Intelligence (INF13208L)

1 - Introduction to Artificial Intelligence
2 - State space search: Problem solving. Actions as transition states operators. Formulation of problems as state space searchs. Complexity analysis, complete and optimal algorithms
Constraint satisfaction problems: design and alternative resolution methods. Local search: Hill climbing, simulated anealing and genetic algorithms.
3 - Decision in Games Played
4 - knowledge Representation and reasoning
Description of problems in first order logic. Choice of vocabulary, construction of rules, axioms and theorems. Knowledge representation of common sense.
Representation of problems that evolve: action and change. Representation of time and change with time constraints
Formalisms for representing action and change: Situation Calculus and Event Calculus. Planning actions with these formalisms. Frame problems, qualification and ramification
5 - Planning: Strips Notation. Partial order planner
Planning with situations calculus and event calculus

Back

Internship/Project (INF13212L)

This course unit has no specific program content, depending on the selected internship/project. However, it will use the knowledge acquired in the other curricular units of the program.

Back

Entrepreneurship and Innovation (GES2310L)

Module 1 – Introduction to Entrepreneurship and Innovation
a. Definitions and concepts of Entrepreneurship
b. Profile and characteristics of entrepreneurs
c. Social entrepreneurship and intrapreneurship
d. What is innovation? Types of innovation
d. Dynamics of innovation

Module 2 – Conception and Structuring business ideas
a. Process and techniques of generating ideas
b. Design Thinking tool
c. Evaluation of business ideas
d. The process of creating a business idea and firm
e. Simulation games- from ideas to business formation

Back

Compilers (INF13213L)

1. Execution models
1.1. Activation records
1.2. Memory organization
2. Intermediate representation
3. Code generation
3.1 Abstract machines
3.2 Just-in-time compilation
4. Optimizations
4.1. Basic blocks and traces
4.2. Instruction selection
4.3. Liveness analysis
4.4. Register alocation
5. Advanced topics
5.1. Garbage collection
5.2. Compilation of object-oriented languages
5.3. Compilation of functional languages
5.4. Polymorphic types
5.5. Dynamic linking

Back

Integration and Analytical Processing of Information (INF13209L)

1. Transactional (OLTP) and analytical (OLAP) systems
2. OLAP systems architecture, design and construction
3. Data Warehousing
3.1. Architecture
3.2. Design. Bus matrix.
3.3. Dimensional Model
3.4. Data Warehouse Extraction, Transformation, Cleansing, and Loading
3.5. Analysis of various applications
3.6. Data aggregation
4. NoSQL Databases
4.1. Differences between NoSQL and Relational Databases
4.2. Main NoSQL models: key-value, column family, document and graph.
4.3. Relevant applications in each of the NoSQL model types
4.4. NoSQL technologies
5. Analysis Models in Business Intelligence
5.1. BI Lifecycle and Implementation
5.2. BI User Models
5.2.1. Multidimensional Models
5.2.2. Cubes
5.2.3. Mixed methodologies

Back

Security (INF13210L)

- Introduction to security
– Fundamental concepts
– Threats, attacks and assets
– Functional requirements
– Design Principles
– Security strategies

- Cryptography
– Symmetric and asymmetric cryptography
– Message authentication
– Hash functions
– Public key encryption
– Digital signatures and key management

- Authentication
– Electronic authentication principles
– Authentication types

- Access control
– Fundamental principles
– Roles and attributes
– Identity, credentials and access management
– Trust frameworks

- Software Security
– Security Problems
– Manipulation of input and output data
– Secure software
– Interaction with the OS and other programs
- Attacks and threats
– Common attacks and threats

- Intrusions
– Intrusion detection
– Firewalls and prevention systems

- Security management
– Organization context and security policies
– Security risk analysis
– Security plans
– Infrastructure security and human resources

Back

Mobile Systems and Applications (INF13211L)

Introduction to mobile systems: characteristics, constraints and and challenges.
Development architecture methodologies and patterns for mobile systems
Implementation of mobile applications
* Android
* (Progressive) Web Apps