



Study Plan

School: School of Sciences and Technology
Degree: Master
Course: Informatics Engineering (cód. 721)



1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours	
Options-Group 1						
Component code	Name		Scientific Area Field	ECTS	Duration	Hours
INF13255M	Signal analysis and processing		Informatics	6	Semester	156
INF13272M	Data Warehousing		Informatics	6	Semester	156
INF13275M	Multimodal Interaction		Informatics	6	Semester	156
INF13265M	Non-conventional Architectures and Programming Languages		Informatics	6	Semester	156
INF13263M	Data Compression and Coding		Informatics	6	Semester	156
INF13256M	Cloud Computing		Informatics	6	Semester	156
INF13264M	Mobile and Ubiquitous Computing		Informatics	6	Semester	156
INF13274M	Game Design		Informatics	6	Semester	156
INF13276M	Software Engineering		Informatics	6	Semester	156
INF13258M	Information Extraction and Ontologies		Informatics	6	Semester	156
INF13262M	Applied Artificial Inteligence		Informatics	6	Semester	156
INF13273M	Data Mining		Informatics	6	Semester	156
INF13257M	Search and Optimisation		Informatics	6	Semester	156
INF13266M	Parallel Programming		Informatics	6	Semester	156
INF13259M	Information Retrieval for Text Bases		Informatics	6	Semester	156
INF13267M	Neural networks and deep learning		Informatics	6	Semester	156
INF13261M	Knowledge Representation and Reasoning		Informatics	6	Semester	156
INF13268M	Robotics		Informatics	6	Semester	156
INF13269M	Security of Computer Systems		Informatics	6	Semester	156
INF13270M	Robotics Support Computational Systems		Informatics	6	Semester	156
INF13260M	Natural Language Processing Systems		Informatics	6	Semester	156
INF13271M	Database Technologies		Informatics	6	Semester	156
INF13666M	Human-Machine Interfaces		Informatics	6	Semester	156
MAT13664M	Cryptography		Informatics	6	Semester	156
INF13667M	Embedded Systems		Informatics	6	Semester	156

**1st Year - 1st Semester**

Component code	Name	Scientific Area Field	ECTS	Duration	Hours		
Options-Group 0							
Component code	Name			Scientific Area Field	ECTS	Duration	Hours
GES10968M	Information Systems Management			Management	6	Semester	156
GES10935M	Strategic Management			Management	6	Semester	156
GES12667M	Statistics for Business I			Management	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13665M	Seminars	Informatics	6	Semester	156



1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Options-Group 1					
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INF13255M	Signal analysis and processing	Informatics	6	Semester	156
INF13272M	Data Warehousing	Informatics	6	Semester	156
INF13275M	Multimodal Interaction	Informatics	6	Semester	156
INF13265M	Non-conventional Architectures and Programming Languages	Informatics	6	Semester	156
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MAT13664M	Cryptography	Informatics	6	Semester	156
INF13667M	Embedded Systems	Informatics	6	Semester	156



2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13277M	Preparation of the Dissertation	Informatics	6	Semester	156

Options-Group 1

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF13255M	Signal analysis and processing	Informatics	6	Semester	156
INF13272M	Data Warehousing	Informatics	6	Semester	156
INF13275M	Multimodal Interaction	Informatics	6	Semester	156
INF13265M	Non-conventional Architectures and Programming Languages	Informatics	6	Semester	156
INF13263M	Data Compression and Coding	Informatics	6	Semester	156
INF13256M	Cloud Computing	Informatics	6	Semester	156
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INF13667M	Embedded Systems	Informatics	6	Semester	156



2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
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Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GES10968M	Information Systems Management	Management	6	Semester	156
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Dissertation					

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
Dissertation					

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para aprovação na componente curricular é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades Curriculares:

1.º Ano{ \ }newline

1º Semestre:

4 UC Optativas do Grupo 1 num total de 24 Ects

1 UC Optativa do Grupo 0 num total de 6 Ects

2º Semestre:{ \ }newline

1 UC Obrigatória num total de 6 Ects

4 UC Optativas do Grupo 1 num total de 24 Ects

2.º Ano{ \ }newline

3º Semestre:{ \ }newline

1 UC Obrigatória num total de 6 Ects

1 UC Optativa do Grupo 1 num total de 6 Ects

1 UC Optativa do Grupo 1 OU do Grupo 0 num total de 6 Ects

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Para obtenção do grau de Mestre é necessário também a aprovação em Dissertação, no total de 42 ECTS, no 3.º e 4.º Semestre. ***

Program Contents



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Signal analysis and processing (INF13255M)

Types of signals:

Discrete and continuous time signals.

Unidimensional and bidimensional signals, audio and image.

Sampling: sampling frequency, Nyquist theorem, aliasing.

Frequency analysis of discrete time signals:

Discrete Fourier Transform, Fast Fourier Transform (FFT).

Z-Transform.

Linear systems: time response, convolution, FIR and IIR systems.

Frequency response of linear systems.

Low-pass, band-pass and high-pass filters.

Linear filter design: Butterworth and Chebychev. Filters based on the FFT.

Linear prediction: minimization of the mean square error, Yule-Walker equations, Levinson and Durbin algorithms.

Nonlinear filters: median filter for noise and outliers removal.

Stochastic processes/

Prediction, filtering and smoothing problems.

Space state and Kalman Filter.

Digital Signal Processors (DSP).

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Data Warehousing (INF13272M)

1. Systems modeling: fundamental principles.

2. Introduction to Data Warehousing

2.1 Fundamental concepts

2.2 The importance of Information in organizations

2.3 Benefits and Reasons to Create a Data Warehouse System

3. Components of a Data Warehouse

4. The Dimensional Model

4.1 Fact tables

4.2 The dimension tables

4.3 Association between fact tables and dimension tables

5. Case Studies

6. Building the Data Warehouse

6.1 Design steps

6.2 Bus Matrix

6.3 Dimension tables hierarchies

6.4 Bridge tables

7. Data analysis

7.1 Cube

7.2 OLAP tools



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Multimodal Interaction (INF13275M)

Human-Machine Interaction Concepts

Interaction Modes

Speech and write as interface

Voice synthesis

Speech Recognition

Writing recognition

Tangible Interfaces

Computer vision: image processing methods (features, filters, edge), automatic detection, recognition and tracking

Architectures for Multimodal Interaction Systems and approaches to the combination of modalities

Perspectives of future development in the area of Human-Machine Interaction

Recent case studies with Deep Learning in Person-Machine or Environment-Machine interaction processes

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Non-conventional Architectures and Programming Languages (INF13265M)

UMA and NUMA parallel architectures.

Shared memory.

DSM and PGAS memory systems.

Programming of concurrent systems with POSIX Threads and MPI.

Virtualization.

Languages ​​for concurrent systems.

Streaming languages.

Grids and Cloud Infrastructure (SaaS / PaaS / IaaS).

Performance analysis.

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Data Compression and Coding (INF13263M)

Introduction to the Shannon information theory.

Source-channel-Receiver.

Models for an information source: discrete memoryless source and sources with memory.

Markov chains. Stationary distributions.

Definition of entropy, conditional entropy and mutual information. Properties.

Source coding theorem.

Entropy encoding algorithms:

Shannon, Shannon-Fano and Huffman codes.

Shannon-Fano-Elias code and arithmetic coding.

Universal encoding algorithms:

Adaptive Huffman coding.

Lempel-Ziv codes: LZ77, LZ78, LZW.

Definition of channel capacity for discrete memoryless channels. Blahut and Arimoto algorithm.

Channel coding theorem.

Channel coding algorithms. Error detection and correction.

Parity check.

Repetition and Hamming codes.

Turbo codes and low density parity check codes (LDPC).

Introduction to lossy compression and rate-distortion theory.



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Cloud Computing (INF13256M)

Cloud Computing: origin and fundamental characteristics
Cloud types and delivery models
Using and managing containers
Virtualização
Storage as a service
Distributed databases
Computing as a service
Scale, provisioning and elasticity: self-managing frameworks and strategies
Building a SaaS solution
Data analytics in cloud environment
Machine learning in the cloud
Data streaming
Big Data and MapReduce
Security and privacy concerns in cloud environment

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Mobile and Ubiquitous Computing (INF13264M)

Introduction to Ubiquitous Computing
Wireless communication networks
Mobile adaptive computing
Data dissemination and management
Context-aware computing
Location-based services
Systems for mobile platforms:
Symbian
Android
iOS



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Game Design (INF13274M)

Elementary Blocks

Bases

Elements of game design

Drawing of puzzles

Convert digital games into physical games

Chance and ability

Elements of chance

Strategy elements

Elements of Dexterity

Balance between chance and skill

Writing Game Concepts

Intellectual property

Development of sequels

Reach a market

Learn an unknown genre

Draw a game to tell a story

Additive and subtractive design

Add and remove mechanics

Multiplayer games

Special topics (optional)

The user interface

Games and art

Games as pedagogical tools

Serious games

Casual games

Games and social networks



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Software Engineering (INF13276M)

Software testing
Test based software development processes
Behavior based software development processes
Software evolution
Evolution process
Evolution dynamics
Software maintenance
Management of legacy systems
Software reuse
Software reuse methods
Applicational frameworks
COTS reuse
Component based Software Engineering
Components
Component models
Component composition
Engineering of distributed software
Associated problems
Server-client systems
Architecture patterns
Software as a service
Service based architectures
Services as reusable components
Service engineering
Service based software development
Software execution environments
Containers
Virtual machines
Configuration management
System building
Deployment processes
Continuous integration
Continuous deployment
Infrastructure configuration
Software management
Project management
Project planning
Software quality
Process improvement

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Information Extraction and Ontologies (INF13258M)

1. Basic concepts: document collections, information extraction, text mining, ontologies, question-answer systems. 2. Evaluation measures. Standard measures - precision, recall, f-measure - and conferences: QA @ CLEF, TREC QA.
3. NLP symbolic approaches: lexicon, syntax, semantics, pragmatics, ontologies. 4. Non symbolic approaches: extraction of information through automatic learning techniques - SVMs, neural networks/deep learning.
5. Hybrid approaches.
6. Case Studies: automatic ontology population, semantic tagging - "semantic role labeling", automatic summarization, question-answer systems.



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Applied Artificial Intelligence (INF13262M)

Uncertain knowledge and reasoning

- (1) Introduction to Uncertainty
- (2) Theory of probability: Syntax and semantics of probability theory, Bayes' rule and Independence;
- (3) Introduction to Bayesian Networks: Syntax, Semantics; distributions parameterized
- (4) Inference in Bayesian networks; Exact Inference by enumeration, elimination of variables; Approximate Inference by Stochastic Simulation; by Markov Chain Monte Carlo
- (5) Temporal Probability Models: Time and uncertainty Inference, hidden Markov models, Kalman filters, dynamic Bayesian networks, particle filtering
- (6) Applications of Bayesian Networks and Models of Probability: Speech Recognition, Task natural language processing.
- (7) Rational decisions: preferences, utility networks, decision and value of information
- (8) Learning from observation, learning by induction, decision trees; Measuring the performance of learning, statistical learning.; Bayesian Learning: learning maximum likelihood parameters with complete data.

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Data Mining (INF13273M)

The Data Mining process

Types of problems: pattern association, clustering, outlier detection, classification

Data preparation: extraction, cleaning, selection, reduction and transformation of attributes, sampling and subsampling

Mining of: streams, text, time series, discrete sequences, spatial data, graphs, web data

Measures of similarity and distances

Problems, approaches and algorithms

Association of patterns

Analysis of clusters

Algorithms: K-means, EM, PCA, SOM, ...

Performance evaluation

Classification

Ensemble methods. Problems with unbalanced classes

Performance metrics: precision, recall, F-measure, ROC curve, Log loss and others (cost function, Cohen's kappa, G-score)

Regression

linear and nonlinear models.

performance evaluation: quadratic errors, absolute errors, absolute errors, correlation coefficient

Analysis of outliers (supervised and unsupervised)

Measures of complexity/simplicity

Mixed performance criteria

Preservation of privacy

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Search and Optimisation (INF13257M)

State-graphs and the A* algorithm

Constraint Satisfaction Problems (CSP)

Constraint Solving Techniques

Constraint Programming

Combinatorial Optimization Problems (COP)

Local Search techniques

Metaheuristics

Applications



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Parallel Programming (INF13266M)

Parallelism and competition

Systems for parallel computing

- multicore, multiprocessor, cluster, heterogeneous
- shared and distributed memory
- caches, consistency and consistency
- communication and synchronization

Support for parallel programming

- atomic accesses
- lock, traffic light, monitor
- critical section, race
- exchange of messages

Programming Models

- threads Posix
- OpenMP
- MPI

Drawing of parallel algorithms

- task parallelism
- data parallelism
- standards for parallelism

Performance of parallel programs

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Information Retrieval for Text Bases (INF13259M)

1. Introduction; main concepts and problems
2. Boolean, vectorial, and probabilistic models
3. Indexing, lemmatization, stop-words
4. Ontologies
5. Query Languages
6. Evaluation
7. Searching the web
8. Semantic web
9. Text classification
10. Text clustering
11. Information extraction
12. Question-Answering systems

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Neural networks and deep learning (INF13267M)

Basic concepts

basic architecture

perceptron

multi-layer networks

Activation and loss functions

Network training: backpropagation algorithm

practical issues

overfitting, vanishing, convergence difficulties

Feed-forward networks, recurring networks

Deep learning architectures:

cnn, lstm, transformers

Model explainability: intrinsic vs post-hoc, model specific or agnostic, global vs. local



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Knowledge Representation and Reasoning (INF13261M)

- (1) Conceptual maps and semantic networks.
- (2) propositional descriptive logics
- (3) Formalization of Knowledge Bases
- (4) Ontologies
- (5) Descriptive Logic and Databases.
- (6) Time and causality
- (7) Semantic Web

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Robotics (INF13268M)

Paradigms in robotics. Sensors, actuators, perception, planning and control.

Sensors:

A/D converters, sampling frequency and resolution.

Physical quantities: position, velocity and acceleration, force; perception of the environment, distances and images.

Actuators:

D/A converters.

Motors and drivers. Sound and Image.

Embedded Systems: Microcontrollers, microprocessors and single board computers.

Operating Systems: Real time systems, Robot Operating System (ROS).

Planning and control hierarchy.

Control:

Dynamical systems and stability.

Trajectory following.

Control algorithms.

Planning: Graphs and potentials. Optimization.

Perception: Building world models (vision, LIDAR, rangefinders, etc).

Simulation.



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Security of Computer Systems (INF13269M)

- Malicious Software
- Types of Malicious Software
- Countermeasures

- Denial-of-Service Attacks
- Distributed Denial-of-Service
- Defenses
- Responses

- Intrusion Detection
- Intruders
- Intrusion Detection
- Analysis Approaches
- Honeypots

- Operating System Security
- Security Planning and Maintenance
- Application Security
- Linux/Unix, Windows and Virtualization Security

- Internet Security Protocols and Standards
- Secure E-Mail and S/MIME
- SSL and TLS
- HTTPS
- IPv4 and IPv6

- Internet Authentication Applications
- Kerberos
- X.509
- Public-Key Infrastructure

- Wireless Network Security
- Mobile Device Security

- Linux Security
- Security Model
- Filesystem Security
- Vulnerabilities
- Access Controls

- Security Auditing
- Security Auditing Architecture
- Security Audit Trail
- Logging Function
- Audit Trail Analysis

- Legal and Ethical aspects
- Cybercrime and Computer Crime
- Intellectual Property
- Privacy
- Ethical Issues



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Robotics Support Computational Systems (INF13270M)

Key elements

General Challenges of Robotics

Perception

Acting

Behavior

Vision and Mapping

Simulation and Reality

Routines

Walking on the line (2D)

Patrol (2D)

Bring the warehouse (3D)

Extensions (optional)

Sensors and actuators

Mobile Robots

Software Libraries

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Natural Language Processing Systems (INF13260M)

(1) lexical analysis;

(2) Parsing: logic grammars (DCGs, XGS), tags, and HPSGs CFG.

(3) Semantic Analysis: DRT, and other semantic for natural language, compositionality.

(4) Pragmatic Analysis: Theory of speech acts, anaphora resolution, dialogue.

(5) Applications of natural language processing systems

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Database Technologies (INF13271M)

1. Database Environment

2. Database Design

3. Application Design

4. Data Availability

5. Performance Management

6. Database Security

7. Database Backup and Recovery

8. Distributed databases



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Human-Machine Interfaces (INF13666M)

Human-Computer Interaction (HCI): what, why, when?

Human and technological factors in HCI

Characteristics of interactive systems

Interaction models

Interaction styles

interaction paradigms

Usability principles

User and task analysis

Interaction design process:

Design Rules

Prototyping

Dialogs design

Screen design

Evaluation techniques

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Cryptography (MAT13664M)

Integers

Congruences and Residue Class Rings

Encryption

Probability

DES

Public-Key

Discret Logarithms

Hash Functions

Digital Signatures

Finite Fields

Elliptic Curves

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Embedded Systems (INF13667M)

- Introduction: motivation and applications.

- ◦ Smart-cards

- ◦ mobile phones

- ◦ control systems

- ◦ sensor networks

- Embedded system architectures

- ◦ ARM architectures, intel, MIPS, microcontrollers - PICs, Atmel AVR 2

- ◦ Operating systems for embedded systems

- Communication in embedded systems and distributed embedded systems

- Real-time systems

- ◦ critical systems, digital processing and control systems

- Design methodologies and design of embedded systems

- Development for embedded systems

- ◦ Development platforms

- ◦ Memory management

- ◦ Cross-compilation

- Applications

- Final work: work of high complexity requiring a vision of integrating several sub-systems and the use of different applications / programming tools



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Information Systems Management (GES10968M)

1. Information, processes and business.
2. Information systems to the organizations.
3. Evaluation of the investments on information systems.
4. Emerging trends on information systems.

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Strategic Management (GES10935M)

- 1 - Introduction;
- 2 - Conceptual pictures of reference;
- 3 - Roots and evolutionary logics of the strategy;
- 4 - The strategic manager;
- 5 - Schools of strategic approaches: several typologies;
- 6 - Innovation and strategy;
- 7 - Strategic classic planning versus strategic modern planning: multiple strategic decisions.

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Statistics for Business I (GES12667M)

Module 1. Descriptive Statistics

1.1. Central measure location

1.2. Deviation measures (Variance, Standard error, Correlation coefficient it's analysis as a measure of market's risk)

Module 2. Making a Database using the SPSS program

Module 3. Inference statistics

3.1 Estimation and properties of estimators

3.2 Confidence intervals

3.3. Tests of statistical hypothesis

Module 4. Regression analysis with seccional data

4.1 Hypothesis of OLS

4.2. Estimation of OLS

4.3. Properties of OLS estimators

4.4. Regression analysis with qualitative independent variables

4.5. Inference analysis in regression context

4.6. Empirical applications in management

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Seminars (INF13665M)

R&D projects presented by IT companies; includes a seminar on "Research Methods".

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Preparation of the Dissertation (INF13277M)

Techniques and methods in research projects

Research of scientific information:

research and select publications in databases of scientific publications and other types of publications

Guest Tutorials

Elaboration and defense of the report of the dissertation project