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Polytechnic Institute of Coimbra (P COIMBRA 02)

Coimbra Institute of Engineering - ISEC

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Informatics and Systems Engineering Department

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ECTS CATALOGUE

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The main language of instruction at Coimbra Institute of Engineering is Portuguese. However, some courses from degree and master programs can be offered in English and/or with a tutorial support in English.

The ECTS catalogue includes subject contents in English. The Students can choose subjects from this Catalogue to the study plan proposal (Learning Agreement) to be analyzed carefully by the Departmental Coordinators and to be adjusted if necessary.

This ECTS catalogue contains information which is valid for this academic year. ISEC reserves the right to adjust the courses offered during the academic year and is not responsible for typing errors or printing mistakes.

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Polytechnic Institute of Coimbra (P COIMBRA 02)  
Coimbra Institute of Engineering - ISEC  
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### ECTS CATALOGUE

## Code 61001- MASTER Informatics Engineering Course

Code	Title - Portuguese	Title - English	ECTS	Period
<b>1.º ano / 1<sup>st</sup> Year</b>				
61001034	Metodologias de Desenvolvimento de Software	Software Development Methodologies	7.5	1º Semester
61001040	Design e Arquitecturas de Software	Software Design and Architecture	7.5	1º Semester
61001088	Sistemas de Apoio à Decisão		7.5	1º Semester
61001077	Análise de Requisitos	Requirements Engineering	7.5	1º Semester
61001055	Data Warehousing	Data Warehousing	7.5	1º Semester
61001066	Machine Learning	Machine Learning	7.5	1º Semester
61001111	Testes e Qualidade de Software	Test and Software Quality	7.5	2º Semester
61001122	Business Intelligence	Business Intelligence	7.5	2º Semester
61001100	Análise de Dados	Data Analysis	7.5	2º Semester
61001133	Big Data	Big Data	7.5	2º Semester
61001144	Ambient Intelligence	Ambient Intelligence	7.5	2º Semester
61001099	Plataformas de Desenvolvimento	Development Platforms	7.5	2º Semester
<b>2.º ano / 2<sup>nd</sup> Year</b>				
61001178	Seminários Industriais	Industrial Seminars	7.5	1º Semester
61001167	Laboratório de Análise de dados	Data Analysis Laboratory	7.5	1º Semester
61001156	Projeto de Software	Software Project	7.5	1º Semester

## M.Sc. in Informatics Engineering Software Engineering Branch

### Requirements Engineering: 1<sup>st</sup> year – 1<sup>st</sup> semester

#### Objectives

Know the theory and practice of the requirements engineering area. Know and apply advanced requirements analysis techniques. Exemplify the application of this knowledge to real problems.

#### Learning Outcomes

At the end of the course students shall be able to

- Analyze a problem, identify its characteristics and design a solution.
- Recognize the advantages and limitations of using the presented methodologies.
- Develop new strategies in an independent and autonomous fashion.

### Software Design and Architectures: 1<sup>st</sup> year – 1<sup>st</sup> semester

#### Objectives

This curricular unit has as main objective to provide students with the knowledge and competence about models, structural patterns and software design techniques.

#### Learning Outcomes

At the end of the course students shall be able to

- Understand the concepts of software design and architecture.
- Understand the role of software design and architecture in the context of a project, with respect to system requirements.
- Know object-oriented analysis methodologies and other design approaches
- Know and apply design patterns.
- Know how to apply enterprise patterns

### Software Development Methodologies: 1<sup>st</sup> year – 1<sup>st</sup> semester

#### Objectives

This curricular unit covers several software development methodologies, including traditional and agile, and addresses software processes, maturity and standards. It aims to provide students with the ability to choose the best approach for the development of a software project.

#### Learning Outcomes

At the end of the course students shall be able to

- Identify the different phases of a software life cycle.
- Know agile and traditional software development methodologies.
- Understand the objectives and levels of software maturity.
- Develop small applications using agile methodologies.
- Justify the application of different methodologies to specific projects.
- Analyze real software development projects.
- Write clear, concise and tangible artifacts.

## **Machine Learning: 1<sup>st</sup> year – 1<sup>st</sup> semester**

### **Objectives**

This curricular unit aims to provide students with knowledge and skills in the area of Machine Learning. Therefore, it is intended that students gain a set of skills that allow them to analyze, in a structured way, real problems of data analysis.

### **Learning Outcomes**

At the end of the course students shall be able to

- Know the stages of a real project based on Machine Learning
- Analyze and prepare a data set
- Correctly identify the aspects related to the validation of the different approaches (metrics, validation strategies,...)
- Know and apply the most relevant algorithms in Supervised Learning
- Know and apply the most relevant algorithms in Unsupervised Learning

## **Ambient Intelligence: 1<sup>st</sup> year – 2<sup>nd</sup> semester**

### **Objectives**

Provide students with a set of knowledge and skills in the area of Ambient Intelligence (Aml): support technologies (such as sensors, actuators, location systems, context awareness, Internet of Things), application of these technologies to collect data, to apply intelligent algorithms and machine learning for Aml, regulations of data privacy and anonymization techniques, intelligent user interfaces.

### **Learning Outcomes**

At the end of the course students shall be able to

- Know and understand the concepts and technologies
- Know, understand and apply data acquisition and fusion techniques from different sensors
- Select and apply appropriate machine learning techniques to the data collected to infer patterns about the context and its dimensions
- Understand the requirement for adaptability of interfaces to user needs
- Know and promote privacy in the acquisition, protection and treatment of the data collected

## **Big Data: 1<sup>st</sup> year – 2<sup>nd</sup> semester**

### **Objectives**

This curricular unit aims to provide students with concepts, techniques, tools and platforms of big data processing, with focus on NoSQL databases.

### **Learning Outcomes**

At the end of the course students shall be able to

- Known and understand the principles and concepts of storage, processing and analysis of data (Big Data).
- Identify and apply the concepts and storage techniques, processing and analysis of data (Big Data) to solve practical problems.
- Use No SQL databases

- Select and use appropriate tools, for storage, processing and analysis of large volume of data (Big Data)

## **Test and Software Quality: 1<sup>st</sup> year – 2<sup>nd</sup> semester**

### **Objectives**

To provide students the fundamental concepts about software testing analysis, design and implementation, as well as software quality management.

### **Learning Outcomes**

At the end of the course students shall be able to

- Understand the concepts related to software quality
- Know and understand software quality metrics
- Plan and execute software tests.
- Evaluate the quality of software at each development stage.
- Identify the appropriate testing techniques to use based on the product and development stage.
- Know and apply test coverage criteria.
- Use testing tools.

## **Development Platforms: 1<sup>st</sup> year – 2<sup>nd</sup> semester**

### **Objectives**

To provide students with knowledge and experience in the development and delivery of medium and large-scale software products. Current platform solutions, automation of procedures, architectures, etc. are addressed, complemented with a strong practical approach to their implementation.

### **Learning Outcomes**

At the end of the course students shall be able to

- Know, understand and apply the concepts of continuous development and continuous delivery.
- Know, choose and apply the supporting tools for continuous development and continuous delivery.
- Plan and implement pipelines for continuous development and continuous delivery.
- Know and understand the architecture based on micro-services
- Plan and implement systems according to the micro-service-based architecture

## **Industrial Seminars: 2<sup>nd</sup> year – 1<sup>st</sup> semester**

### **Objectives**

The main objective of this course is to provide a close contact between the students and the industry and to train some important soft skills, namely related to the ability of effectively writing and presenting technical reports and scientific papers.

### **Learning Outcomes**

At the end of the course students shall be able to

- *Understand and analyze real problems of the industry.*
- *Propose and justify solutions for specific cases in industrial scenarios.*
- *Write scientific papers.*

## **Software Project: 2<sup>nd</sup> year – 1<sup>st</sup> semester**

### **Objectives**

The main objective of this course is to provide knowledge, understanding and practice of managing and developing software projects, as an engineering activity. Students participate in the development of a software project, being involved in all activities related to project management, from requirements elicitation, analysis, architecture, implementation and quality assurance. Issues related to communication, group dynamics, professional practice are also put to the test.

### **Learning Outcomes**

At the end of the course students shall be able to:

- Prepare a software development plan, including estimates, scheduling, resources allocation, configuration management, change control management and risk management.
- Track and control scheduling, risk, resources, changes.
- Write a quality assurance plan and apply different quality control techniques to guarantee the quality of the delivered software product.

## M.Sc. in Informatics Engineering Intelligent Data Analysis Branch

### Software Development Methodologies: 1<sup>st</sup> year – 1<sup>st</sup> semester

#### Objectives

This curricular unit covers several software development methodologies, including traditional and agile, and addresses software processes, maturity and standards. It aims to provide students with the ability to choose the best approach for the development of a software project.

#### Learning Outcomes

At the end of the course students shall be able to

- Identify the different phases of a software life cycle.
- Know agile and traditional software development methodologies.
- Understand the objectives and levels of software maturity.
- Develop small applications using agile methodologies.
- Justify the application of different methodologies to specific projects.
- Analyze real software development projects.
- Write clear, concise and tangible artifacts.

### Machine Learning: 1<sup>st</sup> year – 1<sup>st</sup> semester

#### Objectives

This curricular unit aims to provide students with knowledge and skills in the area of Machine Learning. Therefore, it is intended that students gain a set of skills that allow them to analyze, in a structured way, real problems of data analysis.

#### Learning Outcomes

At the end of the course students shall be able to

- Know the stages of a real project based on Machine Learning
- Analyze and prepare a data set
- Correctly identify the aspects related to the validation of the different approaches (metrics, validation strategies,...)
- Know and apply the most relevant algorithms in Supervised Learning
- Know and apply the most relevant algorithms in Unsupervised Learning

### Data Warehousing: 1<sup>st</sup> year – 1<sup>st</sup> semester

#### Objectives

This curricular unit aims to provide knowledge of data warehousing and data warehouse projects, including fundamental concepts, architectures, multidimensional modeling, data extraction and transformation.

#### Learning Outcomes

At the end of the course students shall be able to

- Have knowledge and understand Data Warehousing subjects.

- *Analyze, design, build and manage a data warehouse.*
- *Apply the knowledge acquired in solving specific problems in professional life.*
- *Have a professional attitude in the development of their tasks due to the acquired knowledge and the ability to understand its scope, applicability and opportunity in the face of specific everyday situations.*

## **Decision Support Systems: 1<sup>st</sup> year – 1<sup>st</sup> semester**

### **Objectives**

The aim of this curricular unit to provide students with the necessary concepts to a specialist who can serve as an interface between a Decision Support System (DSS) and the staff of a company. On the other hand, the student must be able to implement the model subsystem of a DSS itself. The knowledge acquired can be applied in solving similar algorithms/problems in a real context.

### **Learning Outcomes**

At the end of the course students shall be able to

- Understand the importance of decision support systems and the main concepts related with decision support systems.
- Identify the different types of optimization and decision problems, as well as the distinct methodologies that can be used to solve them.
- Identify the suitable algorithm that can be used to solve a simple decision problem.
- Solve simple practical problems using the appropriate optimization algorithms and interpret the obtained solution(s).
- Perform autonomous study and research work.

## **Ambient Intelligence: 1<sup>st</sup> year – 2<sup>nd</sup> semester**

### **Objectives**

Provide students with a set of knowledge and skills in the area of Ambient Intelligence (Aml): support technologies (such as sensors, actuators, location systems, context awareness, Internet of Things), application of these technologies to collect data, to apply intelligent algorithms and machine learning for Aml, regulations of data privacy and anonymization techniques, intelligent user interfaces.

### **Learning Outcomes**

At the end of the course students shall be able to

- Know and understand the concepts and technologies
- Know, understand and apply data acquisition and fusion techniques from different sensors
- Select and apply appropriate machine learning techniques to the data collected to infer patterns about the context and its dimensions
- Understand the requirement for adaptability of interfaces to user needs
- Know and promote privacy in the acquisition, protection and treatment of the data collected

## **Big Data: 1<sup>st</sup> year – 2<sup>nd</sup> semester**

### **Objectives**

This curricular unit aims to provide students with concepts, techniques, tools and platforms of big data processing, with focus on NoSQL databases.



### Learning Outcomes

At the end of the course students shall be able to

- Known and understand the principles and concepts of storage, processing and analysis of data (Big Data).
- Identify and apply the concepts and storage techniques, processing and analysis of data (Big Data) to solve practical problems.
- Use No SQL databases
- Select and use appropriate tools, for storage, processing and analysis of large volume of data (Big Data)

## Data Analysis: 1<sup>st</sup> year – 2<sup>nd</sup> semester

### Objectives

This curricular unit aims to present a set of techniques and methodologies based on deep neural networks to solve real data analysis problems. By understanding the potential of these systems and by gaining the ability to develop architectures with these characteristics will give students a set of specialized skills to work in the area of computational data analysis.

### Learning Outcomes

At the end of the course students shall be able to

- Know and understand advanced concepts in the field of intelligent data analysis
- Understand the main architectures of deep neural networks, namely convolutional networks and recurrent networks.
- Develop deep neural networks for application to practical problems
- Understand the main characteristics of reinforcement learning and understand the situations in which it should be applied
- Use machine learning tools for the development, training and validation of data analysis models

## Business Intelligence: 1<sup>st</sup> year – 2<sup>nd</sup> semester

### Objectives

Provide students with knowledge about modern techniques and tools to support business decision-making based on data extraction and analysis. These include datawarehouses, OLAP and datamining techniques.

### Learning Outcomes

At the end of the course students shall be able to

- Know, understand and use data warehouses, OLAP systems, data mining algorithms and development tools.
- Implement data warehouses, OLAP systems, KPI's.
- Implement pivot tables, dashboards and reports.
- Apply, evaluate and get conclusions from data mining techniques.
- Supervise and implement projects in the BI field.
- Have a perspective of the use and importance of BI in models such as Balanced Scorecards.

## **Industrial Seminars: 2<sup>nd</sup> year – 1<sup>st</sup> semester**

### **Objectives**

The main objective of this course is to provide a close contact between the students and the industry and to train some important soft skills, namely related to the ability of effectively writing and presenting technical reports and scientific papers.

### **Learning Outcomes**

At the end of the course students shall be able to

- Understand and analyze real problems of the industry.
- Propose and justify solutions for specific cases in industrial scenarios.
- Write scientific papers.

## **Data Analysis Laboratory: 2<sup>nd</sup> year – 1<sup>st</sup> semester**

### **Objectives**

This curricular unit has as main objective to guide understanding the main stages of the data analysis process, to study the main characteristics of some of the most relevant problems in the area of data analysis, as well as the techniques used in data analysis problems.

### **Learning Outcomes**

At the end of the course students shall be able to

- Understand the main steps of the data analysis process
- Apply pre-processing and visualization techniques to real data
- Select, adapt and apply learning techniques to create useful predictive models of real context data
- Assess the quality of the models created in all relevant areas
- Know and understand the main characteristics of some of the most relevant problems in the area of data analysis