UNIVERSITETI I EVROPËS JUGLINDORE
УНИВЕРЗИТЕТ НА ЈУГОИСТОЧНА ЕВРОПА
SOUTH EAST EUROPEAN UNIVERSITY

| Study program | Computer Sciences |
|---|---|
| Faculty | Contemporary Sciences and Technologies |
| Study Cycle | Second Cycle (Postgraduate) |
| ECTS | 60 |
| Code | DS-60 |
| Title | Master in Computer Sciences - Module: Data Science |
| Accreditation archive number [60] | 03-231/1 |
| Accreditation archive number [] | |
| Decision for starting of the program | |
| Accreditation date | 07.02.2023 |

## Description of the program

Changes in the field of computer sciences and their application are very dynamic. The main challenge of the research and studies in this area is developing new advanced systems and technologies that will provide solutions in the area of information and communication technologies. Information and communication technologies have become the largest, the most important and the most developed sectors that are rapidly expanding in the European Union and the global market. In addition, the emergence of new markets for the software and telecommunications sector in South East Europe has led to increased demand for highly qualified and specialized professionals in this field. Graduate students can work as professional software engineers or as software architects in the development of software companies or in IT departments of various different enterprises. The high level of professional skills will enable graduate students to become successful leaders in the software industry.

## Career

The program will supply students with the necessary knowledge and skills so that they can contribute in all aspects of the software development process, including planning, collaboration, specifications, design, development, delivery and maintenance of software products. In addition, students will also acquire general skills, such as analytical and critical thinking, teamwork including multicultural environments, planning and organization. After finishing this program, the graduates will have career opportunities in a variety of industries, mainly fulfilling the needs for designing computer systems, developing software for mobile and Web applications, working as database engineers, managers of software projects and processes, etc. depending on the track the students will choose within this study program. The last semester of studies includes master thesis writing, enabling program graduates to continue their studies towards a doctoral degree in computer sciences.

## Learning outcomes

**Knowledge and understanding**

- Ability to develop and implement original and creative IT ideas to ensure the quality and design and managing applications related to telecommunications applications areas such as security and quality assurance;
- Ability to apply IT skills and knowledge and demonstrate specialized competencies in computer sciences and information technologies in order to organize and connect telecommunications processes like a structure that is managed and monitored both in terms of data flow and in terms of creating user interfaces;
- Having knowledge and understanding of areas such as computer sciences and engineering (programming, web technologies, databases, networks, computer and information systems and multimedia);
- Having knowledge of one or more areas of the telecommunications industry that can upgrade students to expert s in the application of knowledge in a given area;

**Applying knowledge and understanding**

- Ability to critically, independently and creatively solve problems in new and unfamiliar environments with no previous experience in telecommunications;
- Planning, management and evaluation of independent research in the field of telecommunications as well as development and implementation of appropriate tools for testing, simulation and implementation;
- Creativity and originality in the interpretation of the knowledge in informatics to solve problems related to the objectives of the industrial production area of telecommunications;

**Making judgement**

- Ability for creative integration and synthesis of knowledge from several areas in the telecommunicationsfield, and administration processes and systems using IT tools designed and created for a specific issue.
- Creating educational processes using computer tools and techniques;
- Ability to deal with complex situations associated with specific processes resulting in real-time telecoms space;
- Ability to identify appropriate specialized instances and make sound judgments in situations of lack of complete information or data based on personal, social and ethical principles and responsibilities associated with the application of knowledge and understanding;

**Communication skills**

- Ability to share findings and proposals with rational argument and reliance both with professionals and with unskilled people, clearly and unambiguously;
- Taking considerable responsibility in shared outcomes, running, and initiating activities, etc.

**Learning skills**

- Ability to take responsibility for continued private study in specialized areas of business and information within the networked economy;
- Ability to take responsibility for further professional development and training;

# List of courses

## Semester 1

- [MCS-303] [6.0 ECTS] **Research Methodology**
- [CM191] [6.0 ECTS] **Advanced Algorithms and Data Structures**
- [CM192] [6.0 ECTS] **Formal Methods in Computer Science**
- [6.0 ECTS] **Professional Elective (from the module)***
- [6.0 ECTS] **Professional Elective (from the module)***

## Semester 2

- [CST-THESIS-120] [30.0 ECTS] **Master Thesis**

# Description of courses

## Core courses

- **Research Methodology**
  The purpose of this course is to provide students with knowledge and understanding of different scientific theories and methodologies. Initially the student will be introduced to the conceptual, theoretical definitions and examples of all existing methods of research, hypothesis, direct and indirect variables, validation of the results, the conclusions BIAS and scientific qualitative and quantitative methodologies, "ground research" methodology and other methodological approaches. In each chapter the student will work on practical assignments. After completing the course the student will be able to explain thoroughly and understand the importance of basic scientific concepts, effectively search and find information-relevant literature, identify, describe and formulate scientific problems, make a careful choice of alternative research approaches, thoroughly described, compare and explain the advantages and disadvantages of different scientific methods for collecting quantitative and qualitative data, apply basic scientific methods to analyse quantitative and qualitative data, understand different frameworks for building theory and review and evaluate scientific publications.

- **Advanced Algorithms and Data Structures**
  This course builds on previous knowledge in the area of algorithms and data structures. The goal of the course is to acquaint students with efficient advanced algorithms and adequate data structures that are used to organize, search and optimize data. It also includes the theoretical efficiency of algorithms and its practical determination in order to be able to compare different algorithms. During the course, students will be introduced to several well-known algorithms, particularly search and optimization in complex nonlinear structures such as trees and graphs.

- **Formal Methods in Computer Science**
  This course gives students a comprehensive introduction to formal methods and their application in software specification and verification. It covers some fundamentals in formal methods, including set theory, functions, finite state machines, predicate and temporal logics, and model checking. The course will give students examples of real-world application of these formal techniques.

- **Master Thesis**
  This module enables students to transfer their skills and knowledge to research and carry out more complex tasks related to their master thesis. The module is designed to be fully practical and students to acquire the necessary knowledge and skills to approach writing the thesis. The module has unique return result-to enable students to write the master thesis with minimal difficulties, and with maximum efficiency. The course aims to improve research techniques and style of writing the paper, taking into account the prevention of the usage of illegal means, such as plagiarism and infringement of copyright, which are prohibited by the Statute of SEEU.

## Elective courses

- **Information Retrieval**
  This course attempts to be a comprehensive overview of the field. Its work will require written assignments, programming and a final project. Assignments will provide exposure to commonly used IR datasets. The course offers a number of practical projects in Information Retrieval, focusing on (but not limited to) website search engines. All projects involve programming: the end result is a relatively large-scale, well-documented and efficient software package. Some of the projects may also involve some research (e.g., reading a research paper and implementing its ideas).

- **Data Analysis with Python/R**
  Aims of the course: ● To be able to understand basic data analytics methodologies ● To be able to use tools that are used for data analytics ● To be able to practically apply their knowledge from the fields of statistics and data analytics ● To be able to present their results through various reporting and data visualization techniques

- **Mathematics for Data Science**
  Course aims: On successful completion of this course students will be able to: 1. Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra, probability, and calculus. 2. Employ methods related to these concepts in a variety of data science applications. 3. Apply logical thinking to problem-solving in context. 4. Demonstrate skills in writing topics from applied mathematics and projects.

- **Social and Information Network Analysis**
  The course focuses on the structure and evolution of networks, drawing on knowledge from disciplines as diverse as sociology, mathematics, computer science, economics, and physics. Online interactive demonstrations and hands-on

analysis of real-world data sets will focus on a range of tasks: from identifying important nodes in the network, to detecting communities, to tracing information diffusion and opinion formation.

- **Neural Networks and Deep Learning**
  The course focuses on the theory, structure and algorithms of neural networks and deep learning. The theory and algorithms of neural networks are particularly important for understanding deep learning concepts, so these this course offers important design concepts of neural architectures in different applications. And it covers the theory and algorithms of deep learning as well, providing detailed discussions of the relationships of neural networks with traditional machine learning algorithms. This theory is linked and described with real world practical applications.

- **Natural Language Processing**
  This course helps students to explore into the exciting world of Natural Language Processing (NLP) giving an overview of major topics in the field. Students will understand how computers work with human language, learn techniques and libraries for data analysis and create natural language processing tools as well. Interactive demonstrations and hands-on analysis of real-world applications will focus on a range of tasks: language translation, text classification, text clustering, sentiment analysis, speech recognition, summarization etc.

- **Data Visualization**
  The aim of this course is to introduce students to the field of data visualization. Students will learn visualization design and evaluation principles, and learn how to acquire, parse, and analyse large datasets. Students will also learn techniques for visualizing multivariate, temporal, text-based, geospatial, hierarchical, and network/graph-based data. Additionally, students will utilize Processing, D3, R and ggplot2, and many other tools to prototype many of these techniques on existing datasets.