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

Study program	Computer Sciences (2016/2017)
Faculty	Contemporary Sciences and Technologies
Study Cycle	Second Cycle (Postgraduate)
ECTS	120
Title	Master in Computer Sciences - Module: Data Engineering
Accreditation archive number [120]	18-354/3
Accreditation archive number []	
Decision for starting of the program	
Accreditation date	23.02.2016

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 Southeast 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. In addition, specialization in four majors such as Data Engineering, Web and Mobile Systems, Software Engineering and Information Systems, will enable graduate students to gain expertise in certain areas and be even more competitive in their workplaces.

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 telecommunications field, 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-101] [6.0 ECTS] **Advanced Databases**
- [MCS-102] [6.0 ECTS] **Object-Oriented Design and Programming**
- [MCS-103] [6.0 ECTS] **Advanced Software Engineering**
- [6.0 ECTS] **Elective course**
- [6.0 ECTS] **Free elective course**

Semester 2

- [MCS-201] [6.0 ECTS] **Advanced Data Strucutres and Algorithms**
- [MCS-201] [6.0 ECTS] **Web Information Systems**

- [MCS-203] [6.0 ECTS] **Distributed Computing**
- [6.0 ECTS] **Elective course**
- [6.0 ECTS] **Free elective course**

Semester 3

- [MCS-301] [6.0 ECTS] **Sofware Interfaces**
- [MCS-302] [6.0 ECTS] **Advanced Datat Engineering**
- [MCS-303] [6.0 ECTS] **Research Methodology**
- [6.0 ECTS] **Elective course**
- [6.0 ECTS] **Elective course**

Semester 4

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

Description of courses

Core courses

- **Advanced Databases**
  The course aims are to continue with an in-depth study of databases. The course is a continuation of the same course from the first study cycle; it starts with some revision of the conceptual database design models (a well-known entity relationship model) and continues with the enhanced entity relationship model. The concept of normalization and normal forms is introduced and is used for database design. The course continues with data storage methods, representing data elements, database system architecture, query processing and optimization, transaction processing concepts, concurrency control techniques, database recovery techniques and database security and authorization.

- **Object-Oriented Design and Programming**
  This course aims to teach a rigorous approach to object-oriented design and programming, with an emphasis on abstraction, modularity, and code reuse as applied to the building and understanding of large-scale systems. In addition to object-oriented concepts, it covers object-oriented modeling using UML, best design practices, design patterns, and their application to real world problem solving and modeling of applications.

- **Advanced Software Engineering**
  The aim of this course is to provide students with knowledge and understanding of advanced software engineering concepts. Initially the students will be introduced to the construction of a clear specification. In addition, the aim is to answer the following advanced aspects of software engineering: What key technical activities are conducted during the clean room software engineering process? How is component-based software engineering used to create systems from reusable components? How does the client/server architecture affect the way in which software is engineered? Are software engineering concepts and principles applicable for Web-based applications and products?

- **Advanced Data Strucutres and Algorithms**
  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 with 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.

- **Web Information Systems**
  This course will introduce technologies for building data-centric information systems on the World Wide Web and show the practical applications of such systems. The subject will focus on the aspects such as technologies and architectures for web information systems, web data management, web data and semantics, social web and web science.

- **Distributed Computing**

This subject introduces graduate students to the advanced topics in distributed computing models, algorithms, and software systems. In particular, the course will emphasize recent techniques used by real-world distributed systems such as distributed file systems, lock services, enterprise data centers, cloud computing, wireless sensor networks and pervasive applications. Case studies on real distributed systems will be conducted, and recent research literature in the subject area will be reviewed.

- **Sofware Interfaces**
  The course helps students learn the principles of designing computer applications to achieve high level of user usability. More specifically, students will gain knowledge of the user-centered design methods, which encompasses designing applications based on analyzing users and the conditions where the application is planned to be used. Additionally, various evaluating methods will be learned that will be implemented to ensure the application built will be highly usable by the users.

- **Advanced Datat Engineering**
  The aim of this course is to learn from data, in order to gain useful predictions and insights. Separating signal from noise presents many computational and inferential challenges, which we approach from a perspective at the interface of computer science and statistics. Through real-world examples of wide interest, students will practically learn how to solve problems using methods and techniques learned in class.

- **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 analyze quantitative and qualitative data, understand different frameworks for building theory and review and evaluate scientific publications.

- **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

- **Knowledge Engineering**
  The knowledge contained in the World Wide Web is available in interlinked documents written in a natural language. To make use of this knowledge, technologies such as natural language processing, information retrieval, data and knowledge mining must be applied. Semantic Web technologies follow an alternative approach by complementing web documents with explicit semantics based on formal knowledge representations, such as, e.g. ontology. The aim of this subject is to learn the fundamentals of Semantic Web technologies and how they are applied for knowledge representation in the World Wide Web. Students will get insight on how to represent knowledge with ontology and how to access and benefit from semantic data on the Web. Furthermore, the focus will be on how to make use of Linked Data and the Web of Data, currently the most popular applications based on Semantic Web technologies.

- **Web Data Mining and Applications for Business Intelligence**
  An in-depth study of the knowledge discovery process and its applications in Web mining, Web analytics and business intelligence. The course provides coverage of various aspects of data collection and preprocessing, as well as basic data mining techniques for segmentation, classification, predictive modeling, association analysis, and sequential pattern discovery. The primary focus of the course is the application of these techniques to Web analytics,

user behavior modeling, e-metrics for business intelligence, Web personalization and recommender systems. Also addressed are privacy and ethical issues related to Web data mining. The emphasis of the course will be on data gathering and practical usefulness.

- **Data Mining**
  Data Mining is one of the most popular fields in Computer Sciences. The objective of this course is to explain to students the advanced methods for data mining from large amounts of data, both in theory and in practical application as well as to evaluate and compare the suitability, scalability and efficiency of different methods. The course will cover advanced topics such as large-scale data mining, similarity search, mining data streams, mining social networks, relational data mining, and matrix factorization methods for data mining.

- **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) web site search engines. All projects involve programming: the result is a relatively large-scale, well-documented and efficient software package. Some of the projects may involve also some research (e.g., reading a research paper and implementing its ideas).

- **Social 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.

- **NoSQL Database Systems**
  Relational database systems have been dominant in the market for over forty years, and remain so today. However, the emergence of distributed and cloud computing, as well as the increasing need for storage of large datasets (i.e., big data, such as human genome, Google search engine, social media data, Large Hadron Collider), have created the need for alternate data storage solutions. A number of different models/database management systems have been developed, that as a group are being referred to as NoSQL databases. A number of large, well-known companies use such databases, including Google, Amazon, Facebook, Twitter, Adobe, MTV, LexisNexis, the New York Times, Forbes and Netflix. This course will explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational databases. Core concepts of NoSQL databases will be presented, followed by an exploration of how different database technologies implement these core concepts. Each of the four main NoSQL data models (key-value, column family, document, and graph) will be analyzed. Also for each of those will be highlighted the business needs that drive the development and use of each database. Finally, we will present criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

- **Database Programming**
  Databases provide a convenient means of storing large amounts of data, allowing it to be sorted, searched, viewed, and manipulated according to the business needs and goals. This course is designed to develop SQL programming proficiency. Emphasis is placed on data definition, data manipulation, and data control statements as well as on report generation. Structured Query Language (SQL) and PL/SQL (Procedural Language/SQL) are covered. Oracle Developer application development utilities and tools will be used to create and manipulate with databases (in Oracle database management system). Topics include data definition and manipulation languages, stored procedures, triggers, indexing techniques, and elementary query optimization.

- **Big Data Analytics**
  Nowadays the data is produced in massive amounts by new acquisition techniques, large network sensors, social networks, various simulations and utilization of different information systems. Turning such large datasets into useful knowledge requires a new generation of scalable algorithms and data management techniques. Therefore, the aim of this module is to explore key data analysis and management techniques which when applied to big datasets are the keystone to new scientific discoveries at large scale, to the business intelligence in Web and enable real-time decision making in distributed environments. By providing balanced view of theory and practice, the course should allow students to understand, use and build big data analytics and management systems.

- **Data Intensive Computing**
  Modern computing applications require storage, management and processing of petabytes of data. The data are not

only extremely diverse, ranging from unstructured text and relational tables to complex graphs, but it is also dynamic. Storing that large amount of data and extract knowledge from large datasets needs new techniques and technologies. This course focuses on developing scalable architectures, algorithms and techniques for supporting various data intensive computation. During this course student will be introduced to infrastructures for data-intensive computing, with a focus on abstractions, frameworks, and algorithms that allow developers to distribute computations across many machines. Topics include core concepts (partitioning, replication, locality, consistency), computational models (MapReduce, dataflow, stream processing, bulk-synchronous parallel), and applications.

- **Service Oriented Architectures**
  The aim of this course is to establish an in-depth study of Service Oriented Architectures (SOA) from three main perspectives: business, architectural and technological point of view. From business perspective, adopting SOA is essential to delivering business agility; therefore, the importance of SOA in industry will be explained. The architectural perspective will discuss different architectural models of software development, with focus on SOA design and design patterns. The technology perspective will provide students with the opportunity to gain the required experience to implement and deploy SOA solutions that will meet different functional and non – functional requirements.

- **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 analyze 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.

- **Rhetoric**
  During its long history of 2,500 years, rhetoric was used to indicate many different things; but rhetoric nowadays is considered as the art of persuasion through language. Rhetoric marks the way that an individual is linked to a particular theme or idea in order to convince the others. Rhetoric is characterized by several distinguishing features.

- **Multilingualism and multiculturalism**
  The purpose of this subject will be multilingualism in multicultural societies as a social phenomenon. This phenomenon is massive in the world. During the lectures, more precise terms such as monoculturalism and multiculturalism will be considered. The term ‘linguistic nationalism’ has at least two forms of this nationalism, which collide with each other: for the leaders of the most powerful countries nationalism means expansion, and for minorities it takes the form of defiance and struggle for the affirmation of identity, despite such pressure. The emphasis during the program will be multiculturalism in education. In the schools curricula consists of contents from different cultures.

- **Selected Advanced Topics in IT Applications for Preparing a Scientific Paper**
  The aim of this subject is: To display the technical elements, the structure of the text and design of a scientific research. To enable students to acquire advanced knowledge and skills from selected advanced chapters of IT applications that will be needed in preparing the scientific and research paper. Practical application of these objectives in preparing student’s individual research paper.

- **Selected Advanced Topics in Applications for Statistical Data Processing**
  The aim of this subject is: To display the technical elements in the field of statistics: organizing, processing, comparing through analysis and publication of data. To enable students to acquire advanced knowledge and skills from selected advanced chapters of the applications for statistical data processing. Practical application of these objectives in statistical processing of data obtained from questionnaires, reports, scientific studies and other documents.

- **Professional Communication**
  The course is focused on the development of those communication skills that are essential for effective functioning in the professional world. Students will study the process for analysis of different communication situations, and will accordingly comprehend them. Among the themes that will be covered are communication in organization, interpersonal and group communication, oral presentations, interviews for employment, professional business letters and interpersonal skills including group dynamics and teamwork.

- **Labor Market**
  The main aim of the course “Labor Market” is to provide second cycle students with basic and in-depth knowledge in

the field of labor market theory and the mechanism of functioning of the market economy. The objective of the course Labor Market is to provide and teach students about categories, laws and basic principles through which the labor market functions. The course makes a detailed analysis of behavior pattern and the role that key agents play in labor market: individuals, companies and government. The analysis is based on two basic categories - labor demand and labor supply, which are applied in almost all the topics that are addressed in this course. The knowledge gained by the students from this course, serves as essential theoretical basis necessary to understand and grasp the different theories and policies that are applied in the labor market. The course teaches students to understand how labor markets distribute and use efficiently the rare factor of production- the labor. Lectures include knowledge about the concepts of labor demand and labor supply and their practical application; behavior of individuals in the labor market, in order to maximize their usefulness; behavior of companies in the labor market, aiming profit maximization; government's role in the labor market, the different structures of labor markets: labor market in full competition, monopoly in the labor market, the role of unions in the labor market, the bilateral monopoly in the labor market. Lectures and class discussions cover material that may not be in the book and some aspects of the material contained in the basic literature will not be discussed in class, but are left for active studying of the student. Therefore in order the student to achieve success in learning the course is to be present in lectures and workshops by participating actively in the discussion of various issues related to labor market.

- **Methodology of Teaching**
  The aim of the course is to introduce the students to the basic teaching approaches and methods. They are expected to gain knowledge and skills in order to be able to apply the active educational tools. The course also offers development, learning and teaching as concepts and basic practices that allow teachers to teach about the development of thinking. Throughout this course, students will gain both theoretical background and entirety of strategies that will enable them to reflect and develop both their own and their students' critical thinking.

- **Philosophy of Social Sciences**
  This module covers information that will provide the learner to gain knowledge, skill and competence of the social sciences, including general methodology (explaining, theorizing, testing), the application of philosophy (especially individualism versus holism), the nature of rationality, and the history of theories and concepts. This module offers an advanced survey of current debates about the ontology, methodology, and aims of the social sciences. It will focus on the central issues of the social sciences: Ethno methodology; Evolution; Phenomenology; Rationality; Relativism; Scientific Methods; Textual Interpretations. Learning outcomes: On successful completion of the course, students will be able to: Understand the goal of social sciences. Tell the difference between explaining and understanding human behavior; To explain the different approach in explanation of the social sciences compare the natural sciences, the peculiarities about human beings and social phenomena; To understand the social structures, practices, norms, institutions, etc. The relationship between individuals and larger social structures; To explain the rely not only on facts about individuals and their mental states, but also the cases in which social phenomena cannot be explained in terms of individual behavior; To understand the value-laden in a different way or to a different degree than natural science, the possibility to have a value-free social science, the possibility to have an objectivity in social science.

- **Project Management**
  On successful completion of the course, students will be able to: plan the activities necessary to implement the project, identify their interdependencies, their duration and costs; prepare the necessary reports and perform all the required communication between the project and the client, as well as among the team members and the other stakeholders. structure the project to its constituent activities; prepare a Gantt-chart and a network plan for the project and identify the shortest time needed to complete the project; use MS Project as a tool in the process of planning, implementation and review of the project; define the project, identify its scope and objectives and develop project specification;

- **Optimization Methods**
  The aim of this course is to present techniques of modeling and optimization in order to prepare students for developing their ability to prepare models for solving real problems in the field of computer science. The course explore the importance of matrix factorizations as an important tool which offers modality for optimizing the solutions of different numerical algorithms which are of basic interest for problem solving in the area computer sciences. The course introduces optimization theory and approach to find the optimum. The different methods of optimization will be analyzed such as the simplex method, duality problem and sensitivity of the problems of linear programming. The aim is to explore a computer implementation for each of the problems followed by the proposal of the corresponding model for optimization.

- **Ethical and Legal Issues in Information Technology (IT)**
  Aims of the course program: to develop an understanding of the relationship between computing, technological

change, society and the law; to emphasize the powerful role that computers and computer professionals play in a technological society; to provide an understanding of legal areas which are relevant to the discipline of computing; to provide an understanding of ethical concepts that are important to computer users and professionals; to provide experience in the consideration of ethical matters and the resolution of ethical dilemmas.

- **Protection of Human Rights**
  The purpose of this course is: to introduce students with the concept of international law on human rights, their implementation, influence of those rights in the creation of national policies; to encourage students to critically reflect on the relationship between international law and national law; make them aware of current international events, how they affect the daily lives of people in the world; encourage students to contribute in matters of drafting laws for the protection of human rights hoping that, the law makers will consult them same during the creation and implementation of state policies.