UNIVERSITY OF PIRAEUS
INFORMATION AND COMMUNICATION TECHNOLOGIES
DEPARTMENT OF DIGITAL SYSTEMS

POSTGRADUATE STUDY PROGRAMME

"INFORMATION SYSTEMS & SERVICES"

STUDY GUIDE

PIRAEUS 2024-2025

1 INTRODUCTION

The Master's Program "Information Systems & Services" of the Department of Digital Systems of the University of Piraeus has been operating with postgraduate students since the academic year 2004-2005, constantly updating according to modern technological developments and the needs of the market. Its orientation is educational, scientific and professional. The teaching staff of PMS currently consists of 10 faculty members, 2 E.D.I.P. members, 6 researchers, and is highly qualified and suitably specialized to carry out high-level teaching and research.

It consists of three (3) distinct specializations (all the scientific components of the term "information systems and services"):

- Advanced Information Systems
- Big Data and Analytics
- IT Governance

Since the first year of graduation, approximately 900 PMS graduates have been registered. PMS graduates are directly absorbed into the market at a rate of over 95%, as the PMS significantly contributes to meeting the needs of the Greek market in new specialties (e.g. data analyst) in which there is, worldwide, a shortage of executives.

The main purpose of PMS is the promotion of scientific knowledge and research for the development and management of digital systems and services in the Knowledge Society. In this context, PMS graduates can staff services and organizations of the public and private sector of the economy, as well as research and education institutions matters related to the development, application and management of digital technologies, systems and services.

2 ADMINISTRATIVE BODIES

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3 OVERVIEW

Information systems and the services they implement represent the driving force of digital evolution and highlight their fundamental importance in all sectors of society. These systems include services and software that facilitate the collection, processing, storage, and distribution of data. In the business sector, they contribute to optimizing business processes, making data-driven decisions, and enhancing competitiveness. Additionally, they play a crucial role in science and research by facilitating the analysis of complex problems. Information systems enhance communication, provide accessible information, and offer modern digital services to citizens, facilitating bureaucracy. With continuous technological advancement, information systems and digital services are gaining increasing importance, making them a fundamental tool for the modern society and the economy.

Advanced information systems represent a critical component of modern technological advancement and have extensive applications across many sectors. They enable the collection, analysis, and interpretation of large volumes of data, providing valuable insights for prediction and decision-making. In the business world, advanced information systems are used to optimize processes, detect market trends, and address challenges. Simultaneously, in the field of research and science, they facilitate mass automated data analysis and knowledge extraction. Advanced information systems incorporate intelligent subsystems, artificial intelligence, machine learning algorithms, while facilitating large-scale analysis of big data, substantially contributing to achieving advanced levels of performance and innovation.

Managing big data and analytics are fundamental technological tools in the modern digital world, contributing to many sectors. The importance of big data lies in the ability to analyze and extract significant information from vast volumes of data, originating from various heterogeneous sources such as social networks, electronic transactions, and sensors. Analytics focuses on extracting valuable insights from this data, providing predictions, trends, and patterns that can support decision-making. Consequently, big data combined with analytics allow businesses and organizations to make informed and intelligent decisions, predict customer needs, and improve their processes. With the evolution of technology, big data and analytics continue to drive innovation and performance in many fields, from healthcare to science and entrepreneurship.

IT governance represents a critical component of managing and controlling information resources within an organization. The significance of IT governance arises from the need to align IT technology with strategic goals and business processes. This approach seeks to create a framework that ensures the security of information systems, the compliance with regulations and standards, and the effective use of technological resources. Including fundamental principles such as transparency, accountability, and risk differentiation, IT governance promotes intelligent decision-making and long-term sustainability in the technology and IT sector at the organizational level.

4 LEARNING OUTCOMES

Upon successful completion of the PMS, graduates will be able to:

- Have specialized knowledge about the architecture of information systems, the integration of analysis and data exploitation in them, and the methodologies of implementing advanced digital services.
- Develop science-based solutions in the design, development and evaluation of large-scale information systems and big data analysis systems for automated decision-making.
- Understand the governance issues of large-scale data systems.
- Understand the fundamentals of the technological, managerial and ethical aspects of IT and telecommunications project implementation.
- Apply the knowledge they acquired and the skills they developed during the program to the analysis and resolution of interdisciplinary problems, applying scientific methodology.
- Design, develop and evaluate projects, independently or collaboratively.
- Collect, evaluate, manage data to analytically solve problems of implementing information systems and services.
- Carry out research work, evaluate alternatives and present results.
- Organize actions and take initiatives to manage projects, while designing and developing original ideas.
- Communicate the results of their research work in the form of a technical report and create presentations for knowledge transfer.

More specifically, the learning outcomes per PMS specialization are as follows.

Upon successful completion of the "Advanced Information Systems" specialization of the PMS, graduates will be able to:

- Understand basic elements of information systems and implement business processes.
- Implement programs using programming techniques and analyze database requirements.
- Build well-structured databases and use tools for design.
- Design and develop algorithms in Java, test programs in a specific programming environment.
- Model business processes with BPMN and execute the processes using management systems.
- Implement applications and computing arrays in a cloud environment.
- Analyze time series data and apply data mining techniques.
- Develop solutions in Python for information systems, use integrated development environments.
- Carry out research work, evaluate alternatives and present results.

- Organize actions and take initiatives to manage projects, while designing and developing original ideas.

Upon successful completion of the PMS "Big Data and Analytics" specialization, graduates will be able to:

- Understand basic machine learning methods and algorithms.
- Design and implement relational and non-relational databases, use SQL for data management.
- Analyze problems using Python, identify libraries and use tools.
- Develop web-centric systems, integrate optimization and automated code review.
- Design and implement deep learning systems, evaluate their suitability.
- Select and implement predictive methods, evaluate results of predictive methods.
- Search for and summarize study findings in a systematic way.
- Organize actions and take initiatives for project management.
- Innovate, develop ideas, communicate results.
- Analyze and evaluate results of machine learning algorithms.

Upon successful completion of the "Information Governance" specialization of the PMS, graduates will be able to:

- Design, implement and evaluate information systems development strategy.
- Design innovation methodologies and apply best practices in knowledge management.
- Choose IT governance standards and evaluate governance strategies.
- Design quality management strategies and apply best practices in its management.
- Design economic and technical study of information system and analyze the cost and performance of IT project.
- Apply methodologies for acceptance and adoption of digital technology and analyze the costs of developing digital systems.
- Apply best risk management methodologies and analyze operational situations and problems in risk management.
- They organize actions to manage projects and develop original ideas.
- Apply research methods, techniques and algorithms and evaluate alternative solutions to select the most appropriate one.
- Communicate the results of their research work in the form of a technical report and create presentations for knowledge transfer.

5 INFRASTRUCTURE

The MSc in Information Systems & Services is a program of the Department of Digital Systems. This department is housed in a university-owned building of the University of Piraeus located at 150 Androutsou Street. Within this building, there are six fully equipped Computer Engineering laboratories, boasting a total of 160 workstations for undergraduate and postgraduate students. The laboratories operate on weekdays from 09:00 to 21:00 and are equipped with modern hardware and software, continuously upgraded and enriched.

Additionally, the Department has amphitheaters and classrooms for lectures and computer laboratories for practical training, as well as a library to support learning and research.

6 COURSES PER SPECIALIZATION AND SEMESTER OF STUDIES

The PPS begins in the winter semester of each academic year. A total of ninety (90) ECTS credits are required to obtain the Master's degree. During their studies, postgraduate students are required to attend and successfully pass postgraduate courses, engage in research activities, write papers, etc., as well as complete a Master's Thesis. The teaching of courses follows a blended learning method, combining both distance and face-to-face instruction. At least 10% of the teaching hours (i.e., educational activities guided by the teaching staff of the Postgraduate Program) are conducted in person. The use of asynchronous distance learning methods does not exceed 25% of the credits of the Postgraduate Program. Courses are organized by semester, conducted on a weekly basis, and are taught in the Greek language. In addition to theoretical instruction, optional seminars, tutorials, and laboratory courses may be provided to students as needed. Moreover, courses in fundamental Computer Science subjects may be offered outside the course program.

Specialization: Advanced Information Systems

CODE	COURSE TITLE	ETCS
Α΄ SEMESTER		
ΠΠΣ-181	***Information Systems Development***	7,5
ΠΠΣ-183	***Data Management for Relational and Non-Relational Data Bases***	7,5
ΠΠΣ-184	***The Java Programming Language***	7,5
ΠΠΣ-189	***Business Process Management and Cloud Computing***	7,5
	TOTAL	30
Β΄ SEMESTER		
ΠΠΣ-185	***The Python Programming Language***	7,5

ΠΠΣ-187	***Data Warehouses and Business Intelligence***	7,5
ΠΠΣ-188	***Data Mining and Analysis***	7,5
ΠΠΣ-190	***Intelligent Information Systems and Artificial Intelligence***	7,5
	TOTAL	30
	C΄ SEMESTER	
ΠΠΣ-180	***MSc Dissertation***	30
	OVERALL TOTAL	90

Specialization: Big Data and Analytics

CODE	COURSE TITLE	ETCS
	A΄ SEMESTER	
ΜΔΑ-220	***Machine Learning: Methods and Algorithms***	7,5
ΜΔΑ-282	***Data Management for Relational and Non-Relational Data Bases***	7,5
ΜΔΑ-283	***Data Mining and Preparation***	7,5
ΜΔΑ-290	***Programming and Infrastructures for Big Data: Python and Cloud Computing***	7,5
	TOTAL	30
	B΄ SEMESTER	
ΜΔΑ-285	***Big Data Processing: Techniques and Tools***	7,5
ΜΔΑ-286	***Business Process Analytics and Simulation***	7,5
ΜΔΑ-287	***Predictive Analytics***	7,5
ΜΔΑ-289	***Deep Learning and Artificial Intelligence***	7,5
	TOTAL	30
	C΄ SEMESTER	
ΜΔΑ-280	***MSc Dissertation***	30
	OVERALL TOTAL	90

Specialization: IT Governance

CODE	COURSE TITLE	ETCS
	A΄ SEMESTER	
ΠΔ-300	***IT Strategy***	7,5

ΠΔ-310	***Knowledge and Innovation Management***	7,5
ΠΔ-320	***IT Governance and Standards***	7,5
ΠΔ-340	***Quality Management and Best Practices***	7,5
	TOTAL	30
Β΄ SEMESTER		
ΠΔ-330	***IT Project Management***	7,5
ΠΔ-350	***IT Acceptance and Adoption***	7,5
ΠΔ-360	***IT Costing and Procurement***	7,5
ΠΔ-370	***Risk Management and Service Level Agreements (SLA)***	7,5
	TOTAL	30
C΄ SEMESTER		
ΠΔ-380	***MSc Dissertation***	30
	OVERALL TOTAL	90

The modification of the course program and the redistribution of courses among semesters can be made by decision of the competent bodies (Coordination Committee, Assembly, and Senate) and will be included in the Operating Regulation of the PSP.

7 INDICATIVE TIMETABLE PROGRAM 2023-2024

UNIVERSITY OF PIRAEUS DEPARTMENT OF DIGITAL SYSTEMS POSTGRADUATE STUDY PROGRAMME "INFORMATION SYSTEMS & SERVICES" TIMETABLE PROGRAM WINTER SEMESTER 2023-2024					
COURSE CYCLE: 6ος					
SEMESTER : 1ο / Winter 2023-2024					
DAY	**MONDAY**	**TUESDAY**	**WEDNESDAY**	**THURSDAY**	**FRIDAY**
SPECIALIZATION: ADVANCED INFORMATION SYSTEMS					
COURSE	The Java Programming Language	Data Management for Relational and Non-Relational Data Bases	Information Systems Development	Business Process Management and Cloud Computing	
ROOMS	G02 ground floor	G02 ground floor	G02 ground floor	G02 ground floor	
INSTRUCTORS	A. Prentza V. Koufi	G. Vassilacopoulos C. Doulkeridis	G. Vassilacopoulos A. Menychtas	G. Vassilacopoulos D. Kyriazis	
SPECIALIZATION: BIG DATA AND ANALYTICS					
COURSE	Data Management for Relational and Non-Relational Data Bases	Programming and Infrastructures for Big Data: Python and Cloud Computing	Machine Learning: Methods and Algorithms	Data Mining and Preparation	
ROOMS	KEKT-103	KEKT-103	KEKT-103	KEKT-103	
INSTRUCTORS	G. Vassilacopoulos C. Doulkeridis	D. Kyriazis N. Sgouros	I. Maglogiannis O. Telelis	M. Filippakis M. Halkidi	

UNIVERSITY OF PIRAEUS					
DEPARTMENT OF DIGITAL SYSTEMS					
POSTGRADUATE STUDY PROGRAMME "INFORMATION SYSTEMS & SERVICES"					
TIMETABLE PROGRAM SPRING SEMESTER 2023-2024					
COURSE CYCLE: 6ος					
SEMESTER : 2ο / Spring 2023-2024					
DAY	**ΔΕΥΤΕΡΑ**	**ΤΡΙΤΗ**	**ΤΕΤΑΡΤΗ**	**ΠΕΜΠΤΗ**	**ΠΑΡΑΣΚΕΥΗ**
SPECIALIZATION: ADVANCED INFORMATION SYSTEMS					
COURSE	The Python Programming Language	Intelligent Information Systems and Artificial Intelligence	Data Mining and Analysis	Data Warehouses and Business Intelligence	
ROOMS	KEKT-103	KEKT-103	KEKT-103	KEKT-103	
INSTRUCTORS	N. Sgouros	G. Vassilacopoulos A. Prentza D. Kyriazis	M. Filippakis M. Halkidi	C. Doulkeridis M. Halkidi	
SPECIALIZATION: BIG DATA AND ANALYTICS					
COURSE	Deep Learning and Artificial Intelligence	Big Data Processing: Techniques and Tools	Business Process Analytics and Simulation	Predictive Analytics	
ROOMS	G02 ground floor	G02 ground floor	G02 ground floor	G02 ground floor	
INSTRUCTORS	I. Maglogiannis A. Prentza	C. Doulkeridis	G. Vassilacopoulos	M. Filippakis K. Delibasis	

The class hours for all courses are 18:15-21:00. All rooms (except G02 ground floor) are located in the central building of the University (80 Karoli & Dimitriou Street). The new university complex, "Themistocles Complex" (former Olympic Weightlifting Hall), room - G02 ground floor, is located at 4 Kyra of Ro Street in Nikaia.

The above schedules are indicative. The days of course lectures may be subject to change.

8 COURSE OUTLINE

8.1 Specialization: Advance Information Systems

A' SEMESTER

8.1.1 ΠΠΣ-181 - Information Systems Development

Code	**ΠΠΣ-181**
Title	*Information Systems Development*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**George Vasilakopoulos, Emeritus Professor**, Department of Digital Systems, University of Piraeus
Instructors	• **George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus • **Andreas Menychtas, Assistant Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The primary purpose of this course is to enable students carry out all the necessary activities for the development of effective and efficient information systems (IS) in an orderly and organized manner (appropriate IS that provide information to support purposeful human activities). Within this framework, the various concepts used in the process of IS development are presented and several topics that need to be dealt with are analyzed (technical, functional, and financial). The theoretical background of most of these concepts is presented, showing their foundation, and enabling their deeper understanding while providing several real-world examples. The course is founded upon the systemic approach of ISs dictating that ISs are human activity systems aiming at providing feasible and desirable solutions on real world problems.

In general, students are trained to:

- Use widely accepted modern IS development methodologies in line with current best practices.
- Define the underlying technical, functional, and financial factors to select the best possible solution regarding IS development and implementation.
- In addition, students are trained to define the process of IS evolution through the interoperability of existing (legacy) systems to ensure past investments and the capitalization upon the use of modern digital technologies.

Thus, students are expected to acquire significant technical knowledge and skills regarding the development, implementation, operation, and evaluation of modern ISs, from project conception to system implementation and rollout.

After successfully completing the course, students will be able to:

- understand the basic elements of information systems as well as the business processes implemented through the systems
- know the main characteristics of the development methods of information systems and the difficulties presented for their implementation.
- implement information systems using programming techniques and methodologies.

Syllabus

Information systems

Principles of systems analysis, systems of human activity, systems thinking, systems analysis, systems approach to information systems, types of information systems.

Organizations in Information Systems

The organization as a system, the organization as a frame of reference for information systems development, the concept of the organization in information systems, information systems-assisted organizational reengineering.

Information Systems Methodologies

Information systems development methodologies, structured analysis and systems design methodologies, evolutionary or rapid application development methodologies, agile systems development methodologies, collaborative methodologies and end-user systems development.

Life cycle of Information Systems

Information systems development life cycle, advantages and disadvantages, structured life cycle phases, user involvement, documentation, structured systems development techniques, data flow diagrams, requirements specification techniques.

Human-centered and participative development of IT systems, requirements elicitation process, prototyping.

Object-oriented development of information systems, RUP methodology, general principles of the methodology, Unified Modeling Language (UML) diagrams.

Use of DevOps methodologies and tools for the integrated implementation of Development and Operation approaches. Utilization of CI/CD practices (Continuous Integration / Continuous Delivery).

Security of information systems, security policies and enforcement mechanisms, security policies based on user roles, authorization management.

E-Business

Types, types and models of digital services, e-business, basic building blocks, architecture, perspectives and modern strategies, analysis of the role of e-business in achieving competitive advantage, virtual businesses, innovation, virtual business strategy, digital product, modern promotion and pricing techniques digital products, application examples and case studies.

Electronic health

Health systems, necessity of e-health services, cost reduction and improvement of service quality, e-health services and systems, international trends and architectures, best practices of development and operation, security of e-health services. Examples of electronic health services (Electronic health record, electronic home nursing support, electronic prescription, electronic referral, standard systems).

E-Government

The importance, role and challenges of e-government, e-government as a tool for modernization and reorganization of public services, application characteristics, parties involved, roles of stakeholders, presentation and analysis of application characteristics, case studies.

Bibliography

- Vasilakopoulos G. (2018). Information Systems. Tsotras Publications.
- Checkland P. and Holwell S. (2002). Information, Systems and Information Systems – Making sense of the field. Wiley.
- Arthur M. Langer (2010). Analysis and Design of Information Systems. Springer.

- Earl T., Little M., Simon A. and Richbeck T. (2011). Modern SOA Infrastructure: Technology, Design and Governance. Prentice Hall.
- Tony Morgan (2002). Business Rules and Information Systems: Aligning IT with Business Goals. Addison-Wesley.
- Alan Hevner and Samir Chatterjee (2010). Design Research in Information Systems: Theory and Practice. Springer.
- William M. Ulrich and Philip Newcomb (2010). Information Systems Transformation: Architecture-Driven Modernization Case Studies. The MK/OMG Press.
- Olegas Vasilecas, Albertas Caplinskas, Gregory Wojtkowski and Wita Wojtkowski (2010). Information Systems Development: Advances in Theory, Practice, and Education. Springer.
- Phil Simon and Bruce F. Webster (2010). Why New Systems Fail: An Insider's Guide to Successful IT Projects. Course Technology/Cengage Learning.

8.1.2 ΠΠΣ-183 - Data Management for Relational and Non-Relational Data Bases

Code	**ΠΠΣ-183**
Title	*Data Management for Relational and Non-Relational Data Bases*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus • **George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The main objective of the course is to enable students learn modern data management techniques for relational and non-relational databases.

Topics taught include the relational data model, the extended entity – relationship model, database design and implementation, the SQL language, physical storage and query processing and optimization.

Emphasis is placed on understanding modern data management systems and on developing database applications in modern software platforms.

Distributed and parallel databases and modern non-relational systems for high performance and scalability are also discussed.

Through this course, students are expected to acquire significant technical skills in large-scale data management and to learn how to design and implement applications that manage massive amounts of structured, semi-structured and unstructured data.

After successfully completing the course, students will be able to:

- analyze a database design problem and gather requirements for implementing the database system
- design a database at a conceptual and logical level and create appropriate data models
- design and implement databases based on normalization rules
- know and use the appropriate tools for the design and implementation of a relational database
- implement SQL queries to define and manage databases
- design and implement a non-relational database
- evaluate and select the most appropriate data management system for a specific problem

Syllabus

Database management systems

Introduction to database management systems (DBMS). DBMS abstraction levels. DBMS structure.

Relational database design

Relational data model. Normalization. Entity-Relationship (ER) model. Approach, entities, relationships, attributes. Key, participation and integrity constraints. Data requirements specification. Conceptual, logical and physical DB design. ER to Relational model transformation.

The SQL language

Syntax. Types of SQL queries. Nested SQL queries. Aggregation operators. Triggers. Stored procedures.

DB Application development

Access to DB from apps. Application independence. JDBC driver. DB application development.

Indexes and optimization

Physical storage. File organization on disk. Indexing methods. The B+Tree. Processing of relational operators. Optimization.

Non-relational databases

Motivation for non-relational databases (NoSQL). Comparison with relational databases. ACID properties. BASE properties. Eventual consistency. Key-value pair stores (REDIS). Document stores (MongoDB). Wide-column stores (Google's BigTable, HBase, Cassandra). Graph Data Storage (OrientDB).

Document-oriented database development

Modeling and storing data in the form of documents. Document structure design. Denormalization to improve processing performance of complex requests.

The non-relational database MongoDB

Introducing MongoDB. Architecture of MongoDB. Commands/syntax in MongoDB. Functions supported by MongoDB.

The non-relational database ElasticSearch

Unstructured data management. Challenges related to text management. Text indexing and search. Ranking. Weighting of terms. The vector space model. The ElasticSearch system.

Principles of distributed and parallel data management

Row-based and column-based storage. Local and global indexes. Data partitioning techniques. Distributed query processing. Query optimization. Load balancing.

Bibliography

- Vasialkopoulos G. (2009): Database Design, Self-publishing.
- Ramakrishnan R. & Gehrke J. (2002): Database Management Systems, Volume I, 2nd Edition (translated), Giola Publications /McGraw Hill.
- Özsu, M. T., Valduriez P. (2011): Principles of Distributed Database Systems, Third Edition. Springer, ISBN 978-1-4419-8833-1, pp. I-XIX, 1-845.
- Jagadish, H. V., Gehrke, J., Labrinidis, A., Papakonstantinou, Y., Patel, J. M., Ramakrishnan, R., Shahabi, C. (2014): Big Data and Its Technical Challenges. Communications of the ACM, Vol. 57 No. 7, pages 86-94.
- Catell, R. (2010): Scalable SQL and NoSQL data stores. ACM SIGMOD Record, Volume 39 Issue 4, December 2010, pages 12-27.
- Davoudian, A., Chen, L., Liu, M. (2018): A Survey on NoSQL Stores. ACM Comput. Surv. 51(2): 40:1-40:43.

8.1.3 ΠΠΣ184 - The Java Programming Language

Code	**ΠΠΣ184**
Title	*The Java Programming Language*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The aim of the course is to introduce students to the object-oriented way of thinking for modeling and solving problems and to object-oriented programming (object-oriented programming) and to familiarize them with the basic concepts of the Java object-oriented programming language.

More specifically, students

- are taught the basic concepts and techniques that constitute the object-oriented programming model,
- acquire skills in designing and coding algorithms in the Java language, and
- acquire the ability to develop, debug, and test programs in a programming environment.

Through the completion of well-designed laboratory exercises, students are expected to gain practical experience in developing programs in Java.

After successfully completing the course, students will be able to:

- explain the basic principles and techniques that constitute the object-oriented programming model (indicative: classes and objects, inheritance, polymorphism)
- design and develop algorithms in the Java object-oriented programming language
- test programs developed in Java object-oriented programming language in a specific programming environment

Syllabus

Introduction to object-oriented programming

An introduction to object-oriented thinking as an approach to problem modelling and problem solving through programming languages. Fundamental concepts of object-oriented programming. Modelling real-world entities. Objects and Classes.

Introduction to the Java programming language

Syntax and features of the language, variables, data types and representations. Control structures. Paintings.

Classes and Objects

Creating classes and constructing objects. Class Constructors and Methods. Calling methods on objects.

Interaction between objects

Sending messages – calling methods, passing parameters.

Basic concepts of object-oriented programming

Heredity and Polymorphism. Use abstractions and connections. Exception handling. Event handling.

Generic programming
Generic data types, methods, and classes.
Anonymous classes
Files, Streams, and Object Serialization/ Deserialization
Functional Programming
Functional Interfaces, streams, and lambdas.
Server-side programming
Web services, java servlets.
Multi-threading programming
Application development
Graphical User Interface (GUI). JavaFX. Event handling. Development of full functionality programs.

Bibliography

- Paul J. Deitel, Harvey Deitel (2018): Java How to Program, 11th Edition, Pearson, ISBN: 9780134743356.
- Herbert Schildt (2018): Java: The Complete Reference, Eleventh Edition, 11th Edition, McGraw-Hill, ISBN: 9781260440249.
- Christian Bauer, Gavin King, Gary Gregory (2015): Java Persistence with Hibernate, 2nd Edition, Manning Publications ISBN: 9781617290459.

8.1.4 ΠΠΣ-189 - Business Process Management and Cloud Computing

Code	**ΠΠΣ-189**
Title	*Business Process Management and Cloud Computing*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**George Vasilakopoulos, Emeritus Professor**, Department of Digital Systems, University of Piraeus
Instructors	• **George Vasilakopoulos, Emeritus Professor**, Department of Digital Systems, University of Piraeus • **Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

The main purpose of this course is to enable students manage an organization's business processes.

Business process management (BPM) refers to the set of concepts, methods and tools that help organizations define, implement, measure, evaluate and improve their end-to-end business processes.

It combines methods and techniques that are widespread such as business process reengineering (BPR), total quality management (TQM), the lean six sigma method and is supported by technologies such as workflow management, process mining, process analytics and service-oriented systems. Business process management helps increase the efficiency of organizations by coordinating activities, automatically assigning tasks to process participants, and completing processes. International organizations such as the Gartner Group demonstrate that the improvement/optimization of business processes has been, for several years, one of the most important priorities of organizations.

From this course students are expected to acquire substantial knowledge and skills on various methods for recording, analyzing, modeling, evaluating, improving, reengineering, simulating, and enacting business processes as well as on the development of process-oriented IS that are implemented on service-oriented architectures, especially cloud-based ones.

After successfully completing the course, students will be able to:

- build business process models using modeling tools based on the BPMN standard
- perform business processes using business process management systems
- analyze the performance of existing business processes
- create business process management strategies and plans for the implementation of business processes within organizations
- understand the basic features and components of modern computing infrastructures (such as computing and storage clouds)
- know the main tools and techniques for creating and managing computing infrastructures at different levels (application, platform, virtualized infrastructure)
- implement cloud computing applications as well as computing and storage arrays using the most innovative technologies applied at an international level

Syllabus

Business processes

Definition of business processes, intra-business and inter-business processes, process-oriented organizational approach, business process automation, adaptation of business processes to achieve competitive advantage, process-oriented and service-oriented information systems.

Modeling and optimization of business processes

Process modeling requirements, Business process analysis and improvement methods. Mapping process criteria. Process modeling methods and techniques (integration definition for function modeling, data flow diagrams). Analysis of a case study in a process modeling platform.

Business process management life cycle

Process discovery and definition. Process analysis, modeling, monitoring, mapping simulation and optimization. Business process reengineering methodology. Critical success factors. Change management.

Six Sigma methodology

Definition, measurement, analysis, improvement, control, examples, case study.

Business process management in practice

BPR, Business process portfolio. Key competencies. Models for process-oriented organizations. Case study on a real world situation using BPM software.

Workflow Security

Workflow security requirements, authentication, access permission, access control, auditing, privacy, integrity. Workflow security enforcement issues.

BPM in service oriented architectures – Cloud computing

Orchestration and choreography of business processes. Business process management notation (BPMN). Cloud-based development of a process-oriented system and in SOA. Case study in a BPM environment.

Bibliography

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B' SEMESTER

8.1.5 ΠΠΣ-185 - The Python Programming Language

Code	**ΠΠΣ-185**
Title	*The Python Programming Language*
ETCS	**7,5**
Semester	**Β'**
Course Coordinator	**Andreas Menychtas, Assistant Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Andreas Menychtas, Assistant Professor,** Department of Digital Systems, University of Piraeus • **Nicholas Sgouros, Assistant Professor,** Department of Naval Architecture of the University of West Attica

Learning Outcomes

The purpose of the course is to deepen students' understanding of complex systems development methodologies using the Python programming language.
The course is aimed at students who are going to use the language, the methodologies and the tools/platforms presented in a context of autonomous and interconnected systems development.
After successfully completing the course, students will be able to:

- Analyze integrated systems and design solutions with the Python language. Identify libraries and appropriate tools and platforms.
- Use integrated code development environments, tools and libraries, to develop programs in the Python language.
- Incorporate modern and sophisticated software development methodologies and best practices for developing efficient systems in Python, oriented towards web environments. Special focus is given on interoperable, reliable and secure distributed applications.
- Develop systems for use in business logic and intelligence environments.
- Understand new concepts (e.g. quantum computing) and apply these concepts in a professional setting by developing programs in the Python language.
- Apply advanced methodologies of automated control of the program's code (testing).

Syllabus

Structural Elements of Python Language

Python features and syntax (including Python idiomatic features). Python data structures and algorithmic structures. Program structure and functions. Vector and object oriented programming. Inheritance, Exception Handling, Multiprogramming, Multithreading, Visualization, Data Representation Tools and Platforms. Proper programming techniques in Python (God Programming Practices). Core libraries and application development platforms (local/distributed).

Advanced Application Development

Development of applications with integration of graphical user interfaces. Event-Driven Programming in Python. Creation and use of APIs and web application development frameworks. Develop applications to interface, retrieve and manipulate data in relational and non-relational databases. Automation of processes. Use of web services. REST and GraphQL architectures. High performance applications in Python. Decision support applications for business environments (Business logic/Business Intelligence).

Introduction to quantum computing and tools in Python.

Development of Complex Systems

Device management and interaction with the Internet of Things (IoT). Development of computer network management and supervision systems, communication protocols. Recommender systems. Development of system monitoring and evaluation applications. System performance optimization tools and libraries. Online applications. Development of distributed applications with advanced scalability, reliability, and security features. Development of cloud applications. Introduction to concept of edge computing using the Python programming language.

Bibliography

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- S. Sakinmaz (2023), Python Essentials for AWS Cloud Developers, Packt Publishing
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8.1.6 ΠΠΣ-187 - Data Warehouses and Business Intelligence

Code	**ΠΠΣ-187**
Title	*Data Warehouses and Business Intelligence*
ETCS	**7,5**
Semester	**B'**
Course Coordinator	**Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus • **Maria Halkidi, Associate Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

The main objective of the course is to present students with modern techniques and methods for the efficient analysis of data, the extraction of useful information and its presentation in a way that will help the executives of a company to make useful business decisions.

In the context of the course, the main techniques of designing and developing data warehouses as well as analyzing multidimensional data models will be studied.

Also, students will get to know a wide set of data analysis techniques that can be used in understanding business data, extracting knowledge from it and in the decision-making process.

Through this course, students are expected to learn techniques that are part of business intelligence and acquire important technical skills in business data analysis.

After successfully completing the course, students will be able to:

- design and implement data warehouses
- learn techniques that are part of business intelligence
- acquire significant technical skills in analysis data
- analyze time series data
- present data analysis results with the most appropriate visualization technique

Syllabus

Data warehouses

Multidimensional data model, data warehouse architecture, data warehouse design, extract-transform-load data.

Multidimensional data analysis

OLAP functions, query systems in data warehouses, creating reports.

Introduction to Recommender Systems

Introduction to the problem and applications of recommender systems. Introducing the basic techniques for personalized recommendations through content-based approaches, nearest neighbor techniques. User-user collaborative filtering technique, item-item collaborative filtering algorithm.

Advanced recommendation techniques

Matrix factorization methods and hybrid recommendation methods.

Association rules

Methods Finding frequent sets, shopping basket analysis, Apriori algorithm, correlation rule evaluation metrics.

Exploratory analytics and visualizations

Univariate and bivariate analysis, visualization, histograms, cumulative distribution function, summary statistics, measures of location and dispersion, identifying

correlations between two variables, alternative ways of displaying using charts, using visualization techniques for multivariate data analysis.

Analytics with visualization

Data visualization tools and techniques, data analytics with visualization, applications in business intelligence, new user interfaces, advanced visualization techniques, research prototypes.

Time series analysis

Examples and motivation, trend detection, moving averages, smoothing methods, autocorrelation function.

Simulations

The role of simulation for extracting information from data, Monte-Carlo simulation, use of simulation for cases where analytical modeling is complex, development of models with simulation, validation of models with simulation.

Location analytics

Geotagging, location-aware social networks, combination of spatial, temporal and text data, analytics applications targeting geographic social content, location analytics on Twitter, Flickr, Foursquare.

Bibliography

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- Jure Leskovec, Anand Rajaraman, Jeff Ullman. Mining of Massive Datasets. Cambridge University Press. 2014 (2nd Edition).
- Raymond T.Ng et al. (2013): Perspectives on Business Intelligence. Morgan & Claypool Publishers. Synthesis Lectures on Data Management.
- Philipp K. Janert (2010) Data Analysis with Open Source Tools: A hands-on guide for programmers and data scientists, O'Reilly Media.

8.1.7 ΠΠΣ-188 - Data Mining and Analysis

Code	**ΠΠΣ-188**
Title	*Data Mining and Analysis*
ETCS	**7,5**
Semester	**B'**
Course Coordinator	**Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus • **Maria Halkidi, Associate Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The ability to collect and store data has increased significantly as a result of innovation in various areas, such as the internet, e-commerce, electronic transactions, bar-code readers, mobile devices and intelligent machines. Data mining is a rapidly growing field that deals with the development of techniques that aim to help data owners make intelligent use of these collections.

After successfully completing the course, students will be able to:

- understand basic data mining techniques
- know methods for clustering, classification, regression
- apply and implement data mining algorithms
- apply data analysis techniques to text data, world wide web data, and social network data

Syllabus

Basic concepts in data mining and data preparation

Requirements and review of basic data mining tasks. Data cleaning, transformation. Measures of similarity, distance. Summary of analytical forecasting methods.

Clustering

Introduction to basic clustering algorithms for large databases. Spectral clustering methods. Separative-hierarchical clustering. Clustering of non-linearly separable data. Fuzzy clustering. Techniques for evaluating clustering results.

Regression

Linear-multiple linear regression, logistic regression, inverse normal regression (Probit regression), spectral regression, multivariate analysis of variance (ANOVA-MANOVA). Exploratory factor analysis. Database mining and advanced prediction techniques. Experimental design. (Experimental design). Regression-based prediction modeling (forecast prediction, cancer prediction).

Classification

Basic types of categorization. Statistical classification. Discriminant function analysis. Evaluation criteria for categorization methods. Cross-classifications analysis. Typical applications.

Classification algorithms

Decision trees. Support vector machines. Apps with WEKA.

Dimensional reduction techniques

The problem of many dimensions. Presentation of basic dimensionality reduction techniques (PCA, SVD).

Link Analysis
Topics of hyperlink analysis, Page ranking algorithms, Hubs and authorities (HITS).
Social network analysis
Network modeling, graph metrics (degree, betweenness centrality, connected components), clustering coefficient.
Extract communities from graphs
Introduction to the basic concepts of clustering on graph data. Basic techniques for extracting communities from graphs.
Text mining
Text representation model, similarity measures, predictive models for text, clustering techniques.

Bibliography

- Daniel T. Larose, Chantal D. Larose. Data Mining and Predictive Analytics, Wiley, 2015 (2nd Edition)
- Jure Leskovec, Anand Rajaraman, Jeff Ullman. Mining of Massive Datasets. Cambridge University Press. 2014 (2nd Edition).

8.1.8 ΠΠΣ-190 - Intelligent Information Systems and Artificial Intelligence

Code	**ΠΠΣ-190**
Title	*Intelligent Information Systems and Artificial Intelligence*
ETCS	**7,5**
Semester	**B'**
Course Coordinator	**Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus • **Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus • **George Vasilakopoulos, Emeritus Professor**, Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The main objective of the course is to introduce students to modern techniques, systems, and platforms for the implementation of intelligent information systems using Artificial Intelligence and Machine Learning approaches.

Emphasis will be placed on issues related to the scalability of information systems, and their management including monitoring, self-management, and fault tolerance mechanisms in the full life cycle of information systems services. In addition, topics related to the architectures of interconnected information systems services as well as the implementation and use techniques of the aforementioned services will be analyzed.

Through this course, students are expected to acquire significant technical skills in modeling intelligent information systems and learn to design and implement large-scale information systems consisting of complex services.

After successfully completing the course, students will be able to:

- acquire important technical skills regarding the modeling of intelligent information systems
- design and implement large-scale information systems consisting of complex services
- understand issues related to data and application interoperability
- know machine learning and artificial intelligence techniques
- apply artificial intelligence methods

Syllabus

Lambda architectures for the interconnection of information systems services

Approaches to the storage, use and analysis of data through service flows. Batch layer to store the data in a medium, serving layer to create indexes and Real-time processing layer.

Information system as a service approach

Service catalogs and mechanisms for finding, selecting, executing, monitoring, evaluating and costing. Methodology for modeling and developing information systems as a service.

Platform as a Service

Platform approaches to implementing information systems as a service. Serverless computing architectures. Workshop focusing on programming, configuring, and running applications using the Google AppEngine platform and the Apache OpenWhisk platform.

Self-management of information systems
Real-time infrastructure and information system data monitoring and analysis techniques. Scalability, Elasticity and Fault Tolerance Approaches.
Artificial intelligence and machine learning for information systems management
Information system service development profiling services and runtime changes using artificial intelligence and machine learning (neural networks, reinforcement learning) approaches.
Cloud computing and information systems
Modeling and migration of information systems to cloud computing and storage infrastructures. Sizing of necessary resources and real-time feedback techniques to adapt the infrastructure based on the needs of the information systems.
Introduction and neural networks I
Introduction to artificial intelligence and machine learning, problem categories, supervised learning, unsupervised learning, reinforcement learning, examples of applications. Introduction to neural networks, neural network models and architectures, perceptron, linear and non-linear separability, multilayer perceptron, neural network training algorithms.
Neural networks II
Performance evaluation of neural networks, generalizability, neural network development applications, case study.
Clustering I
Definitions, clustering classes, distance functions, similarity functions, partitional clustering, k-means algorithm.
Clustering II
Hierarchical clustering, evaluation and validity of clustering, applications of clustering, case study.

Bibliography

- Aurelien Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2019
- Peter Sbarski, Serverless Architectures on AWS, 2017
- Cagatay Gurturk, Building Serverless Architectures, 2017
- John Arundel and Justin Domingu, Cloud Native DevOps with Kubernetes: Building, Deploying, and Scaling Modern Applications in the Cloud, 2019

C' SEMESTER

8.1.9 ΠΠΣ-180 - MSc Dissertation

Code	**ΠΠΣ-180**
Title	*MSc Dissertation*
ETCS	**30**
Semester	**C'**
Course Coordinator	The director of the MSc program
Instructors	The Faculty Members of the MSc program

Learning Outcomes

The master thesis project aims to extend the student's academic skills, introduce them to a certain research area and potentially motivate them to continue their research work beyond the completion of their Master's Degree. This may be achieved not only by exploiting particular skills and knowledge acquired from taught courses but also by enhancing their ability to tackle a novel research area and/or problem.

In additions, it expands the student's professional skills by developing/improving their ability to research, manage/organise information, think creatively, pursue innovation and report adequately the findings of their research.

After successful completion of the thesis, students will be able to:

- search for appropriate bibliographic sources and summarize the findings of their study in a systematic way
- address difficult problems that include research aspects
- organize actions and take initiatives for project management
- design and develop original ideas in the wider field of information systems and services
- apply research methods, techniques and problem solving algorithms
- evaluate alternative solutions and choose the most suitable one
- communicate the results of the research work in the form of a technical report (thesis text) but also in the form of a presentation

Syllabus

In the third semester of the MSc program, students are expected to complete a postgraduate dissertation (PGD). The PGD should demonstrate advanced theoretical knowledge, practical skills, critical thinking, problem analysis and synthesis, as well as research capability of the student. It may address empirical, theoretical, or applied topics and may be carried out in collaboration with a private or public entity in Greece or abroad dealing with relevant subjects.

The instructors of the MSc program submit thematic areas for postgraduate dissertations, which are made available to the students on LEFKIPPOS. Students choose a thematic area and a supervising Faculty Member, and, with their consent, submit a relevant application to the Secretariat of the MSc program. The writing of the PGD can be done either in Greek or in English.

The examination of each PGD includes a brief presentation and demonstration of any systems developed within it, before the respective examination committee. The

examination committee evaluates the PGD on a specific form, which is signed by its members.

Guidelines for writing the postgraduate dissertation can be found at the following link: https://mscdss.ds.unipi.gr/en/ .

8.2 Specialization: Big Data and Analytics

A' SEMESTER

8.2.1 ΜΔΑ-220 - Machine Learning: Methods and Algorithms

Code	**ΜΔΑ-220**
Title	*Machine Learning: Methods and Algorithms*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Ilias Maglogiannis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Ilias Maglogiannis, Professor,** Department of Digital Systems, University of Piraeus • **Orestis Telelis, Assistant Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The course aims at familiarizing the audience with fundamental machine learning techniques and algorithms that cover the spectrum of diverse machine learning applications (supervised / unsupervised learning).

The expected learning outcome of the course includes knowledge of the basic machine learning methods and gaining of experience in implementing and using them effectively. It also includes the critical ability for the choice of an appropriate methodology for each distinct machine learning problem, along with the deep understanding of its advantages and weaknesses.

After successfully completing the course, students will be able to:

- understand basic machine learning methods and algorithms
- distinguish between supervised and unsupervised learning problems
- choose correct classifiers, feature selection methods, data transformations, and clustering algorithms
- design and implement machine learning methods
- evaluate the results of applying machine learning algorithms.

Syllabus

Introduction to Machine Learning

Types of Machine Learning, Training Methods, Accuracy Metrics, Prediction, Classification.

Maximum Likelihood Classifiers

Bayesian Concept Learning, Likelihood, Model fitting, Naive Bayes Classifier, Bayesian Networks.

Decision Trees

Tree representation, Hypothesis Space Search, Information Gain, ID3 Algorithm, C4.5 Algorithm.

Ensemble Learning and Boosting

Adaboost Algorithm, Random Trees, Combinations of Classifiers.

Gradient Descent for Prediction / Classification

Linear Regression, Logistic Regression, Support Vector Machines. Stochastic Version.

Support Vector Machines
Linear / Non-Linear Classification, Kernel Functions, Multiclass Classification.
Instance-Based Learning
k-Nearest Neighbors Algorithm, Locally Weighted Regression, Traning Examples Selection, RBF Networks.
Programming for Machine Learning in Python
Numpy Library, Visualization with the Matplotlib Library.
Application of Machine Learning in Python
Scikit-learn Library.
Weka
Graphical and Programming Environment, Case Studies, Experimentation.
RapidMiner
Graphical and Programming Environment, Case Studies, Experimentation.

Bibliography

- Mitchell. Machine Learning. McGraw-Hill (International Edition), 1997.
- Bishop. Pattern Recognition and Machine Learning. Springer, 2007.
- Murphy. Machine Learning: A Probabilistic Perspective. MIT Press, 2012.

8.2.2 ΜΔΑ-282 - Data Management for Relational and Non-Relational Data Bases

Code	**ΜΔΑ-282**
Title	*Data Management for Relational and Non-Relational Data Bases*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus • **George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The main objective of the course is to enable students learn modern data management techniques for relational and non-relational databases. Topics taught include the relational data model, the extended entity – relationship model, database design and implementation, the SQL language, physical storage and query processing and optimization. Emphasis is placed on understanding modern data management systems and on developing database applications in modern software platforms. Distributed and parallel databases and modern non-relational systems for high performance and scalability are also discussed. Through this course, students are expected to acquire significant technical skills in large-scale data management and to learn how to design and implement applications that manage massive amounts of structured, semi-structured and unstructured data.

After successfully completing the course, students will be able to:

- analyze a database design problem and gather requirements for implementing the database system
- design a database at a conceptual and logical level and create appropriate data models
- design and implement databases based on normalization rules
- know and use the appropriate tools for the design and implementation of a relational database
- implement SQL queries to define and manage databases
- to design and implement a non-relational database
- evaluate and select the most appropriate data management system for a specific problem

Syllabus

Database management systems

Introduction to database management systems (DBMS). DBMS abstraction levels. DBMS structure.

Relational database design

Relational data model. Normalization. Entity-Relationship (ER) model. Approach, entities, relationships, attributes. Key, participation and integrity constraints. Data requirements specification. Conceptual, logical and physical DB design. ER to Relational model transformation.

The SQL language

Syntax. Types of SQL queries. Nested SQL queries. Aggregation operators. Triggers. Stored procedures.

DB Application development

Access to DB from apps. Application independence. JDBC driver. DB application development.

Indexes and optimization

Physical storage. File organization on disk. Indexing methods. The B+Tree. Relational operators. Optimization.

Non-relational databases

Motivation for non-relational databases (NoSQL). Comparison with relational databases. ACID properties. BASE properties. Eventual consistency. Key-value pair stores (REDIS). Document stores (MongoDB). Wide-column stores (Google's BigTable, HBase, Cassandra). Graph Data Storage (OrientDB).

Document-oriented database development

Modeling and storing data in the form of documents. Document structure design. Denormalization to improve processing performance of complex requests.

The non-relational database MongoDB

Introducing MongoDB. Architecture of MongoDB. Commands/syntax in MongoDB. Functions supported by MongoDB.

The non-relational database ElasticSearch

Unstructured data management. Challenges related to text management. Text indexing and search. Ranking. Weighting of terms. The vector space model. The ElasticSearch system.

Principles of distributed and parallel data management

Row-based and column-based storage. Local and global indexes. Data partitioning techniques. Distributed query processing. Query optimization. Load balancing.

Bibliography

- Vasialkopoulos G. (2009): Database Design, Self-publishing.
- Ramakrishnan R. & Gehrke J. (2002): Συστήματα Διαχείρισης Βάσεων Δεδομένων, Τόμος Ι, Έκδοση 2η (μεταφρασμένο), Εκδόσεις Τζιόλα/McGraw Hill.
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- Jagadish, H. V., Gehrke, J., Labrinidis, A., Papakonstantinou, Y., Patel, J. M., Ramakrishnan, R., Shahabi, C. (2014): Big Data and Its Technical Challenges. Communications of the ACM, Vol. 57 No. 7, pages 86-94.
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8.2.3 ΜΔΑ-283 - Data Mining and Preparation

Code	**ΜΔΑ-283**
Title	*Data Mining and Preparation*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus • **Maria Halkidi, Associate Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The ability to collect and store data has increased significantly as a result of innovation in various areas, such as the internet, e-commerce, electronic transactions, bar-code readers, mobile devices and intelligent machines. Data mining is a rapidly growing field that deals with the development of techniques that aim to help data owners make intelligent use of these collections.

In the context of this course, we study methods that help in the selection and preparation of data before the application of analysis and knowledge mining techniques. Also, the basic techniques used to extract useful knowledge patterns from large data collections are presented. Techniques related to the analysis of various types of data including text, data from the World Wide Web and social networks are studied. Through this course, students are expected to acquire significant technical skills in data analysis and become familiar with algorithms and knowledge mining methods.
After successfully completing the course, students will be able to:

- assess the quality of the data to be analyzed and apply the necessary data preparation techniques
- choose the appropriate data mining technique based on the requirements and data types
- apply data mining techniques
- use appropriate techniques and tools to extract knowledge from data collections
- to evaluate the quality of data mining results

Syllabus

Basic concepts in data mining and data preparation

Requirements and review of basic data mining tasks. Data cleaning, transformation. Measures of similarity, distance. Summary of analytical forecasting methods.

Clustering

Introduction to basic clustering algorithms for large databases. Spectral clustering methods. Separative-hierarchical clustering. Clustering of non-linearly separable data. Fuzzy clustering
Techniques for evaluating clustering results.

Classification

Basic types of categorization. Statistical classification. Discriminant function analysis. Support vector machines. Evaluation criteria for categorization methods. Cross-classifications analysis. Typical applications.

Dimensional reduction techniques
The problem of many dimensions. Presentation of basic dimensionality reduction techniques (PCA, SVD).
Association rules, frequently occurring sets of objects
Apriori algorithm, comparison of algorithms, representative correlation rules.
Link Analysis
Hyperlink analysis topics, Page ranking algorithms, Hubs and authorities (HITS).
Social network analysis
Network modeling, graph metrics (degree, betweenness centrality, connected components), clustering coefficient.
Extract communities from graphs
Introduction to the basic concepts of clustering on graph data. Basic techniques for extracting communities from graphs.
Text mining
Text representation model, similarity measures, predictive models for text, clustering techniques.
Recommendation generating systems
Content-based systems, collaborative filtering systems, personalization, knowledge mining techniques for large-scale recommender systems, evaluation of recommender systems, applications of recommender systems.

Bibliography

- Daniel T. Larose, Chantal D. Larose Data Mining and Predictive Analytics, Wiley, 2015 (2nd Edition)
- Jure Leskovec, Anand Rajaraman, Jeff Ullman. Mining of Massive Datasets. Cambridge University Press. 2014 (2nd Edition).
- Han and M. Kamber . Data Mining: Concepts and Techniques. Morgan Kaufmann, 2006

8.2.4 ΜΔΑ-290 - Programming and Infrastructures for Big Data: Python and Cloud Computing

Code	**ΜΔΑ-290**
Title	*Programming and Infrastructures for Big Data: Python and Cloud Computing*
ETCS	**7,5**
Semester	**Α'**
Course Coordinator	**Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus • **Nicholas Sgouros, Assistant Professor,** Department of Naval Architecture of the University of West Attica

Learning Outcomes

The purpose of the course is to deepen students' understanding of the methodologies for solving complex data processing and analysis problems using the Python programming language.

The course is aimed at students who are going to use the language and tools/frameworks presented in an integrated systems development context for a wide range of theoretical and practical areas stemming from the broader field of data science, including big data organization and analysis problems as well as business logic and intelligence problems.

After successfully completing the course, students will be able to:

- Study data analytics problems and design solutions with the Python language, identifying appropriate libraries, tools, and frameworks.
- Use integrated development environments, tools and libraries to develop programs in the Python language.
- Incorporate modern and sophisticated software development methodologies and best practices for developing efficient Data Analytics oriented systems in Python.
- Develop web-based data retrieval, processing and analysis systems using the Python language.
- Understand and integrate optimization methods at all stages of a data analysis problem either individually or considering all the stages involved in specific algorithms (e.g., leveraging pipeline techniques).
- Applie advanced methodologies of automated testing of the program's code.

Syllabus

Structural Elements of the Python Language

Supported python data structures and algorithmic structures. Program structure and functions. Fundamentals of vector and object-oriented programming required for data manipulation. Visualization and data representation tools. Basic data manipulation, analysis and representation libraries.

Interface with Data Sources

Interfacing, retrieving and manipulating data from relational and non-relational databases. Data cleaning, normalization and grouping, data completion and extension techniques. Examples of data retrieval from various data sources. Creation and use of regular expressions.

Data Modeling and Analysis

Applications of time series analysis (periodicity, trend, seasonality). Sampling, transformations and representation of time series. Feature extraction. Predictive models. Techniques and examples for preprocessing, regression, and building statistical models. Large scale data analysis. Analysis of data from social networks.

Machine Learning Techniques

Development of applications to solve problems using supervised and unsupervised learning techniques, capabilities. Limitations and evaluation of their effectiveness. Techniques and examples of implementations with neural networks. Examples of text analysis with natural language (NLP). Decision trees. Recommender systems.

Python and Cloud Computing

Big data Cloud Infrastructures. Development and deployment of software solutions on the cloud. Process automation and data management. Python tools and platforms for web application development and data management methodologies. Use of APIs and methodologies for deployment and monitoring of python cloud applications.

Bibliography

- M. Facure (2023), Causal Inference in Python, 1st edition, O'Reilly
- H. Karau, B. Lublinsky (2023), Scaling Python with Ray 1st edition, O'Reilly
- S. Sakinmaz (2023), Python Essentials for AWS Cloud Developers, Packt Publishing
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- P. Deitel, H. Deitel (2021), Intro to Python for Computer Science and Data Science: Learning to Program with AI, Big Data and The Cloud, Pearson
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- I. Martin, A. Shukla S. VK (2019), Big Data Analysis with Python, Packt Publishing
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- Nelli (2018), Python Data Analytics, Apress
- Bengfort, R. Bilbro & T. Ojeda (2018), Applied Text Analysis with Python, O'Reilly
- Bowles (2015), Machine Learning in Python, Wiley

B' SEMESTER

8.2.5 ΜΔΑ-285 - Big Data Processing: Techniques and Tools

Code	**ΜΔΑ-285**
Title	*Big Data Processing: Techniques and Tools*
ETCS	**7,5**
Semester	**B'**
Course Coordinator	**Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Christos Doulkeridis, Associate Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The main objective of this course is to present to the students modern techniques, systems and platforms for Big Data management and scalable processing.

Emphasis will be given to issues related to scalability, efficiency and fault-tolerance in the complete life-cycle of Big Data, from data acquisition and integration to data processing and interpretation. In terms of expected results, the students will acquire strong technical skills in management of Big Data and they will be enabled to design and implement algorithms for data processing at scale.

After successfully completing the course, students will be able to:

- develop data-centric applications with an emphasis on performance and scalability
- use the most appropriate big data processing tool and system
- evaluate and improve computationally intensive parts of a big data processing algorithm
- apply the most appropriate data processing techniques suitable for the data under analysis
- develop efficient big data processing algorithms

Syllabus

Big data, advanced modeling techniques and MapReduce

Basic concepts. Applications. Use cases. Definitions. 6Vs -Volume, Variety, Velocity, Veracity, Validity and Volatility. Advanced modeling techniques related to Big Data. Problem formulation. Requirements for large-scale data management platforms. Research opportunities and challenges. The process of analyzing Big Data. Challenges associated with large-scale data. The MapReduce programming framework.

Hadoop & HDFS

The Hadoop distributed file system, replication, fault tolerance, high read throughput. Apache Hadoop as an implementation of MapReduce. Limitations of Hadoop. Designing MapReduce jobs. Data partitioning techniques. Simple operations (counting, addition) and complex operations (conjunctions).

Batch Processing I (Apache Spark)

Parallel Processing, Main Memory Processing, Dataframes in Spark, Columnar and Rowwise Storage Example Usage.

Batch Processing II (Apache Spark)

Resilient Distributed Datasets (RDDs), immutable variables, actions and transformations, lazy valuation, the Spark shell, comparison between Spark and Hadoop.

Batch Processing III (Apache Spark)
Declarative query processing, Spark SQL, programming with Dataframes, Spark's processing engine, data partitioning, working with JSON data.
Real-Time Processing I (Apache Storm)
Dataflow Management Systems, Dataflow Processing, Programming in Apache Storm, Bolts and Spouts, Topologies in Storm.
Real-Time Editing II (Spark Streaming)
Micro-batching, Spark streaming, stateless and stateless processing, windowing mechanisms.
Real-Time Processing III (Apache Kafka)
Apache Kafka, basic concepts, publish/subscribe architecture, real-time pipelined data processing.
The HBase system
Storing data for random access, columnar storage, basic HBase concepts, advanced concepts and features.
Big Data Research Topics
Selected research topics for Big Data management and processing.

Bibliography

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8.2.6 ΜΔΑ-286 - Business Process Analytics and Simulation

Code	**ΜΔΑ-286**
Title	*Business Process Analytics and Simulation*
ETCS	**7,5**
Semester	**Β'**
Course Coordinator	**George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

Business processes are main assets for any organization since they determine how they work. The main purpose of this course is to enable students analyse business processes so that they gain insight and define their performance and compliance. These are the main objectives of business process analytics. Performance is about reducing the amount of time required to take a decision and evaluating the impact of these decisions through certain criteria metrics. Compliance refers to ensuring that processes are carried out in accordance with rules and regulation and that contractual quality obligations of the services provided are met. Business Process Management Systems (BPMS) typically include an analytics component to collect and analyse data (historical and/or real time) regarding the effectiveness and efficiency criteria set with the objective to optimize the business processes. In addition, BPMSs usually include business process simulators which are used for the development of process simulation models that provide data on the effectiveness and efficiency of existing or new processes. Thus, from this course students are expected to acquire significant technical knowledge and skills in understanding the concepts and techniques of business process analysis and are enabled to apply business process analysis methods and techniques in real business environments.

After successfully completing the course, students will be able to:

- build business process models using modeling tools based on the BPMN standard
- perform business processes using business process management systems
- analyze the performance of existing business processes and proceed with the improvement of processes if they are not considered satisfactory based on criteria
- create business process management strategies and plans (plans) for the implementation of business processes within organizations
- design and implement business process simulation techniques

Syllabus

Business Process Management

Characteristics of business processes. Evolution of Business Process Management. Life cycle of Business Process Management.

Identification and Modeling of Business Processes

Construction phases of business processes. Business Process Architecture Design. Modeling business processes using the BPMN language.

Business Process Reengineering

Complete business process reengineering methodology. Case study.

Business Process Analytics Methods and Tools

Sources and types of data for business process analysis. Business process metrics. Business process metrics quality criteria. Types of business process analysis. Business intelligence and process simulation.

Big Data and Business Process Analytics

Business Process Efficiency and Compliance Measure and improve business performance.

Business Process Mining

Use process mining techniques to improve business process compliance and efficiency. Process Mining Algorithms. Process mining tools.

Collections of Business Process Models

Automatic analysis of process model collections. Techniques for comparing process models. Search for process models. Behavioral analysis of process models.

Business Process Improvement

Using analytical methods and technologies to improve the efficiency of business processes. Monitoring the execution of business activities. Recognition of behavioral patterns. Prediction analytics.

Business Process Simulation

Performance prediction. Understanding the impact of change. Process simulation and simulation tools.

Case study

Business Process Analytics Application Development in a BPM Software Environment.

Bibliography

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- Process Mining. Discovery, Conformance and Enhancement of Business Processes. W. Van der Aalst. Springer, 2011.
- Speech and Language Processing. D. Jurafsky and J. Martin. Pearson International Edition, 2008.
- Workflow Modeling: Tools for Process Improvement and Application Development. A. Sharp and P. McDermott, Artech House, 2008.
- Real-Life BPMN: Using BPMN 2.0 to Analyze, Improve, and Automate Processes in Your Company. J. Freund and B. Rücker. CreateSpace Independent Publishing Platform, 2014.
- Improving Business Processes. Harvard Business School Press, 2010.
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- Handbook on Business Process Management. M. Rosemann and J. vom Brocke. Vol. 2, Springer Verlag, Berlin, 2009.

8.2.7 ΜΔΑ-287 - Predictive Analytics

Code	**ΜΔΑ-287**
Title	*Predictive Analytics*
ETCS	**7,5**
Semester	**B'**
Course Coordinator	**Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus • **Konstantinos Delimpasis, Professor,** Department of Computer Science and Biomedical Informatics, University of Thessaly • Support from Laboratory Teaching Staff Members and doctoral candidates

Learning Outcomes

The aim of the course is to introduce students to the basic techniques of data analysis and extracting information from large data sets in order to make predictions about future events. Through this course, students are expected to acquire important technical skills regarding the creation of forecasting models and the application of forecasting techniques.

After successfully completing the course, students will be able to:

- analyze data with appropriate predictive analytics techniques
- choose the appropriate predictive method for data analysis and interpret the results
- implement predictive techniques for real problems and by processing real data
- evaluate the results of predictive methods

Syllabus

Introduction

Course Introduction-Matrix Concepts, Model Method and Function Selection, Data Preprocessing and Multidimensional Data Processing (Introduction to Data Transformations, Introduction to Time Series Analysis, Transformation of non-stationary to stationary time series, testing for independence.

Regression

Linear-multiple linear regression, logistic regression, inverse normal regression (Probit regression), Crest Regression, Static/Dynamic Autoregression and Spectral Analysis. Spectral regression, multivariate analysis of variance (ANOVA-MANOVA). Exploratory factor analysis. Database mining and advanced prediction techniques. Experimental design. (Experimental design). Regression-based prediction modeling (forecast prediction, cancer prediction).

Regression Applications in Matlab

Linear Regression, Logistic Regression, Ridge regression, Supervised Workflow and Algorithms, Supportive Support Machines, Supervised Learning, Unsupervised Learning, Applications.

Thoughtful process

Linear Stochastic Processes, (Moving Average (MA) Processes), Interrelationship of AR and MA Processes, Auto-Switching Average Models (ARMA) (p, q) – Skill Estimation in ARMA (p, q), Box-Jenkins Approximation, ARIMA Models – ARIMA Model Estimation, ARIMA Models, ARIMA Model Forecasting – Diagnostic and Forecasting Model, Static Processes in the Frequency Domain, Spectral Analysis, Non Stationary Time Series, State

Space Models-Kalman Filter, Relaxed Dynamic Models, Moving Medium (MA) Models, Vector autoreversion model, Multivariate models, SARMA models for stationary time series and ARIMA, SARIMA for non-stationary.

Nonlinear predictive models

Time Series Forecasting with Linear and Nonlinear Models, Nonlinearity Overview, Interaction Models, Polynomial Models, Step Models, Piecewise Models, (Linear and Polynomial), Spline Models (MARS), Nonlinear Time Series Analysis and Dynamical Systems, Forecasting with Local Models.

Applications of Time Series Analysis (Matlab)

Practice using Matlab in time series analysis, Using Matlab functions for AR, MA, ARMA, SARMA models, Time Series Programming, Linear Time Series analysis, Non-linear Time Series analysis and applications.

Regression Applications in R language

The R language environment, Syntax, Libraries, Basic Structures and Functions, Linear Regression, Logistic Regression, Linear Time Series Analysis, Using functions for AR, MA, ARMA, SARIMA models.

Applications of Time Series Analysis in R language

Programming for Time Series in R, Experimentation, Functions and programs in the R computing environment, Non-linear analysis of time series, Using Measures of Analysis of Time Series (MATS), Forecasting Applications.

Neural networks

Introduction to neural networks. Activation function. The gradient-descent method. Model representation. Back-propagation algorithm.

Applications of neural networks

Implementation of the backpropagation algorithm for neural networks in MATLAB. Examples of applying neural networks to forecasting problems.

Evaluating learning/prediction models

Model selection and evaluation. Diagnostic vs. Deviation. Validity assessment. Metrics for evaluating prediction results. Learning curves.

Bibliography

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- Brockwell, R. Davis, Introduction to Time Series and forecasting, Springer, 2nd edition.

8.2.8 ΜΔΑ-289 - Deep Learning and Artificial Intelligence

Code	**ΜΔΑ-289**
Title	*Deep Learning and Artificial Intelligence*
ETCS	**7,5**
Semester	**B'**
Course Coordinator	**Ilias Maglogiannis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Ilias Maglogiannis, Professor,** Department of Digital Systems, University of Piraeus • **Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

The aim of the course is to introduce advanced machine learning and artificial intelligence methodologies related to deep learning, performance evaluation and the combined use of basic algorithms, and the preparation and processing of available data for their more efficient use. Expected learning outcomes include a thorough understanding of the performance of deep learning methods, the ability to use them in combination to solve challenging problems, and the ability to analyze data to pre-process it and combine it with the appropriate methodology.

After successfully completing the course, students will be able to:

- explain fundamental concepts of artificial intelligence
- choose an algorithm for solving artificial intelligence problems
- evaluate the usefulness and weaknesses of alternative algorithms and techniques
- model problems as search, constraint solving and logic problems
- understand deep learning architectures
- design and implement deep learning systems
- evaluate the appropriateness of implementing deep learning systems

Syllabus

Introduction

Introduction to artificial intelligence and machine learning, problem categories, supervised learning, unsupervised learning, reinforcement learning, examples of applications.

Neural networks I

Introduction to neural networks, neural network models and architectures, perceptron, linear and non-linear separability, multilayer perceptron, neural network training algorithms.

Neural networks II

Performance evaluation of neural networks, generalizability, neural network development applications, case study.

Clustering I

Definitions, clustering classes, distance functions, similarity functions, partitional clustering, k-means algorithm.

Clustering II

Hierarchical clustering, evaluation and validity of clustering, applications of clustering, case study.

Deep learning and convolutional neural networks I

Introduction to deep learning, concatenation and clustering, deep learning architectures, training deep neural networks.

Deep learning and convolutional neural networks II
Recurrent neural networks, genetic models, detection and segmentation, visualization and understanding, transfer learning.
Deep Learning Lab
Examples of deep learning, Recognition with pre-embedded networks, learning transfer, training and evaluation.
Multidimensional data processing
Multidimensional vision, Feature extraction, Recognition, Classification, Video analysis.
Machine learning in biomedical data
Biomedical data representation, Knowledge extraction, Event and anomaly detection in medical history, machine learning for diagnosis and health strategies.

Bibliography

- Mitchell. Machine Learning. McGraw-Hill (International Edition), 1997.
- Bishop. Pattern Recognition and Machine Learning. Springer, 2007.
- McKinney. Python for Data Analysis. O'Reilly, 2012.
- Raschka. Python Machine Learning. Packt Publishing, 2015.
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- Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, http://www.deeplearningbook.org, 2016.

C' SEMESTER

8.2.9 ΜΔΑ-280 - MSc Dissertation

Code	**ΜΔΑ-280**
Title	*MSc Dissertation*
ETCS	**30**
Semester	**C'**
Course Coordinator	The director of the MSc program
Instructors	The Faculty Members of the MSc program

Learning Outcomes

The master thesis project aims to extend the student's academic skills, introduce them to a certain research area and potentially motivate them to continue their research work beyond the completion of their Master's Degree. This may be achieved not only by exploiting particular skills and knowledge acquired from taught courses but also by enhancing their ability to tackle a novel research area and/or problem.

In additions, it expands the student's professional skills by developing/improving their ability to research, manage/organise information, think creatively, pursue innovation and report adequately the findings of their research.

After successful completion of the thesis, students will be able to:

- search for appropriate bibliographic sources and summarize the findings of their study in a systematic way
- address difficult problems that include research aspects
- organize actions and take initiatives for project management
- design and develop original ideas in the wider field of information systems and services
- apply research methods, techniques and problem solving algorithms
- evaluate alternative solutions and choose the most suitable one
- communicate the results of the research work in the form of a technical report (thesis text) but also in the form of a presentation

Syllabus

In the third semester of the MSc program, students are expected to complete a postgraduate dissertation (PGD). The PGD should demonstrate advanced theoretical knowledge, practical skills, critical thinking, problem analysis and synthesis, as well as research capability of the student. It may address empirical, theoretical, or applied topics and may be carried out in collaboration with a private or public entity in Greece or abroad dealing with relevant subjects.

The instructors of the MSc program submit thematic areas for postgraduate dissertations, which are made available to the students on LEFKIPPOS. Students choose a thematic area and a supervising Faculty Member, and, with their consent, submit a relevant application to the Secretariat of the MSc program. The writing of the PGD can be done either in Greek or in English.

The examination of each PGD includes a brief presentation and demonstration of any systems developed within it, before the respective examination committee. The examination committee evaluates the PGD on a specific form, which is signed by its members.

Guidelines for writing the postgraduate dissertation can be found at the following link: https://mscdss.ds.unipi.gr/en/ .

8.3 Specialization: IT Governance

A' SEMESTER

8.3.1 ΠΔ-300 - IT Strategy

Code	**ΠΔ-300**
Title	*IT Strategy*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

Drawing up an IT strategy is an important factor in the success of modern organizations. The relevant literature states that 84% of information systems fail. Of those that succeed, 40% do not achieve a return on investment, while overall only 8% of successful information systems create value for the organization. The course aims to enable students to acquire the necessary knowledge about digital systems strategy, IT strategy formulation and implementation, and the creation of business plans for IT strategy development.

After successfully completing the course, students will be able to:

- design an information systems development strategy
- implement IT business performance plans
- evaluate IT strategy performance of digital systems and services

Syllabus

Digital technology

Characteristics and challenges of digital technology, the importance of innovation and achieving comparative advantage, definition of digital strategy, relationship between digital strategy and organizational strategy, the importance and role of the chief digital officer (CIO).

Strategic analysis

Resource and process analysis, competitive environment analysis, competitive threat assessment, competition analysis.

Strategic goals

Defining vision and mission, defining goals, defining strategy: priorities, market development strategies, positioning and differentiation strategies, business models, service models, revenue models, market restructuring, supply chain management capabilities, internal knowledge management capabilities, resources and organizational capabilities.

Strategy implementation

Examples of failed strategies, success factors for digital strategy implementation, investment evaluation, the productivity paradox, examples – case study.

Digital business strategy

Digital channel strategies, digital business strategy process models, case study: Apple's digital strategy.

Analysis of strategic digital technology models, outsourcing, acquisition, mergers, evaluation of strategic digital technology models

Case study examples and analysis.

Investigating the role of social networks in shaping and enhancing digital strategy

The role of digital marketing in enhancing digital strategy, digital marketing planning, situational analysis, goal setting, strategy, tactics, customer relationship management.

Digital strategy

For mass media, advertising, retail, industrial production, examples, case study.

Examples of creating a digital strategy

For the service sector, the welfare state, public organizations, financial organizations.

Workshop

Creating a digital strategy and drafting a business plan.

Bibliography

- Alexander Rauser, 2016, "Digital Strategy: A Guide to Digital Business Transformation", CreateSpace Independent Publishing Platform, South Carolina, USA, ISBN 9781519331243.
- David Rogers, 2016, "The Digital Transformation Playbook: Rethink Your Business for the Digital Age", Columbia University Press, New York, USA, ISBN 9780231541657.
- Sangeet Paul Choudary, Marshall W. Van Alstyne and Geoffrey G. Parker, 2016, "Platform Revolution: How Networked Markets are Transforming the Economy and How to Make them Work for You", Norton and Company Inc., New York, USA, ISBN 9780393249132.
- Don Tapscott and Alex Tapscott, 2016, "Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World", Penguin Random House LLC, New York, USA, ISBN 9781101980132
- William Mougayar, 2016, "The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology" Wiley, New Jersey, USA, ISBN: 978-1-119-30031-1

8.3.2 ΠΔ-310 - Knowledge and Innovation Management

Code	**ΠΔ-310**
Title	*Knowledge and Innovation Management*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

We live in a world where rapidly developing technology affects our lives like never before. Digital technology is transforming businesses, economies, and society. Developments in all areas of science and technology are helping to rearrange competition, expand industry boundaries, and transform business operations, sometimes radically. In the modern era of the "Digital Age" the ability to innovate is a key competitive advantage not only for companies but also for individuals, communities, and nations. The coming years will be the era of the "engineer-entrepreneur" and the "Digital Leader". The engineer of the 21st century must have the entrepreneurial spirit, imagination, and management skills to be able to identify needs, propose new solutions, and implement them. In addition, tomorrow's leaders must embrace the digital revolution and recognize the power of disruptive technologies that are disrupting the business arena to ensure the survival of their organizations in an ever-changing environment. This course aims to make students competent in the application of frameworks, methodologies, and best practices of the strategic management of technological innovation in the context of a modern organization that competes in a networked world. The course develops students' skills to think holistically about the role of knowledge management and innovation as part of a strategic planning process for the creation of a new business activity within an existing organization or a startup. An integral part of the course is group work, where groups of students undertake to develop a strategic business plan for the design, development and commercialization of a high-tech product or service of their choice, covering topics such as: market feasibility study, analysis of competition, strategic & business plan.

After successfully completing the course, students will be able to:

- design methodologies for managing technological innovation
- apply best practices of knowledge management and innovation
- develop a knowledge and innovation management business plan
- evaluate the performance of the technological innovation management plan.

Syllabus

Introduction to Creativity, Innovation and Entrepreneurship

Innovative Ideas – Evaluation as Business Opportunities. The importance of innovation for modern society. Definition of Invention and Innovation. The Open Innovation model and the role of the Crowd in the design and development of new products.

Strategic Management of Technological Innovation

Types of Innovation: Radical, Elemental, Architectural or Departmental. Technology trajectory? Technology Diffusion and Market Adoption Curves. Disruptive Innovations & "Innovator's Dilemma" by, Clayton Christensen. Case Study: The Digital Camera Market and the Case of Eastman Kodak.

Opportunity Analysis

Model of the Seven Domains of the Analysis of Attractive Opportunities (Seven Domain Analysis – John Mullins). Assessment of Market & Industry attractiveness. The macro environment of the Market – PESTEL analysis. Critical Issues: Sustainable Development, Circular Economy.

Data as a Competitive Advantage

The role of "big data" (Big Data) in Business Intelligence & the process of making informed decisions. Brief introduction to Big-Data Analytics tools.

Crafting a Corporate Strategy

Vision, Mission & Goals. Setting goals and objectives – the Balanced Scorecard. Growth strategies (Ansoff) and portfolio analysis (BCG). Brief introduction to change management.

Strategic Foundation – Industry Attractiveness & Sustainable Advantage

Why are some industries better than others? The classical approach to strategy (structural analysis, Porter's 5-forces model and value chain analysis). How intelligent interconnected objects are transforming the competition (M. Porter).

On Business Models & the Business Plan

Business Models and the Business Plan: Why are business models important? (Joan Magretta). The Business Model Canvas (Business Model Canvas, by Osterwalder). Introduction to developing a business plan.

Methods of selection of Business Proposals (VC Funding)

Quantitative (Discounted Cash Flow – DCF, Net-Present Value – NPV, Internal Rate of Return – IRR) & Qualitative (Q-Sort, Conjoint Analysis, Data Envelopment Analysis – DEA). Case analysis of Boeing's development of the Dreamliner aircraft model. Raising capital to finance a new business through a venture capital company (VC-fund).

"Social" aspects of new technologies (Soft aspects of new technologies)

Security, Privacy and Trust Issues in the Internet of Everything (IoE) era. Ethics in the Age of Autonomous Vehicles, Robotics, Cyborgs, and "Super-Intelligence" (by Nick Bostrom).

Marketing Strategy over the Product Life–Cycle (PLC)

Marketing strategies for first-time products. Geoffrey Moore's theory of the gap in the Product Life Cycle (PLC) and the recommended strategy for crossing the gap. The Blue-Ocean strategy and value innovation.

Bibliography

- Schilling, “Strategic Management of Technological Innovation,” Int’l 2nd Ed., ISBN-13:978-1259539060, McGraw-Hill, 2012.
- Eric Ries, “The Lean Startup: How Today’s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses,” 2011.
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- Clayton M. Christensen, “The Innovator’s Dilemma”, HarperBusiness; Jan. 2003.
- Geoffrey A. Moore, “Crossing the Chasm”, HarperBusiness; Revised Ed., Aug. 2002.
- Larry Downes, Paul Nunes, “Big Bang Disruption: Strategy in the Age of Devastating Innovation“, Portfolio/Penguin, 2014.
- Pedro Domingo, “The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World”, Basic Books, Sep. 2015
- Nick Bostrom, “Superintelligence: Paths, Dangers, Strategies“,Oxford University

Press, May 2016
- Daniel D. Gutierrez, “Machine Learning and Data Science: An Introduction to Statistical Learning Methods with R”, Technics Publications, Sep. 2015

8.3.3 ΠΔ-320 - IT Governance and Standards

Code	**ΠΔ-320**
Title	*IT Governance and Standards*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

The course aims to provide students with the ability to understand digital governance and knowledge of the standards that govern it. With these skills they will be able to participate in the design of effective IT governance services, with specific and measurable objectives, as well as in dissemination and awareness-raising actions. In addition, they will gain an overview of the European development in IT governance.

After successfully completing the course, students will be able to:

- choose between established IT governance standards
- evaluate governance strategies through measurable objectives of established standards
- apply best practices in IT governance strategy formulation.

Syllabus

Information Governance

The failure of information systems and the necessity for the governance of digital infrastructures, definition of IT governance, principles, components of IT governance, examples and exercises.

Feasibility Study

Definition and types of feasibility studies, the PIECES framework, dimensions of the business feasibility framework (digital systems feasibility, market feasibility, technical feasibility, financial feasibility, operational feasibility and legal feasibility), feasibility study document structure, examples and exercises.

IT governance in practice

Technology-oriented governance (e.g. governance of service-oriented architectures, cloud computing, mobile apps, things (IoT), governance based on the nature of the organization (e.g. digital banking systems, e-health, e- services, virtual organizations, digital organizations, public sector, smart cities), examples and exercises.

European Interoperability Framework (EIF)

Interoperability, solutions and common frameworks for public administration, businesses and citizens, European Interoperability Strategy (EIS), European Interoperability Architecture (EIRA), EIF Levels.

Connecting Europe Facility (CEF) and eProcurement

Introduction to CEF, Digital Services Infrastructure (DSIs) and Digital Services, CEF DSIs governance structure and processes, governance bodies, Examples of successful PEPPOL projects, e-SENS, eProcurement tools.

European Standards in Digital Governance, Public Procurement

From the Bangemann Report and the Lisbon Strategy to the European Interoperability Framework. The process of drawing up governance standards in the E.U. Directive 2014/55/EU and its meaning. The Peppol project, its evolution into Open Peppol. Tools such as e-CERTIS and Open e-PRIOR and their use at European level.

Greek E-Government Standards

Evolution and implementation of the Greek standards: E-Government Service Provision Framework (or E-Government Framework - E-Government Framework). Framework, rules and standards for interoperability and e-Transactions services. Digital authentication framework, rules and standards. Rules, standards and certification of Public Internet sites.

Measurement, evaluation and Digital Single Market

Methods and indicators for measuring and evaluating digital government services at national and European level, the impact of the digital single market on digital governance, interoperability and standards.

Open Data and Open Software

The importance and use of open data. The EU Open Data Portal, Open Government Partnership (OGP), Open Data Institute (ODI) are analyzed. Good practices and emerging trends, its relation to digital governance and open standards. The future of open software in digital governance.

Case study

TAxisnet and MERCURY Web Portal.

Bibliography

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- e-Government: The Use of Information and Communication Technologies in Administration, Eric E. Otenyo and Nancy S. Lind, Teneo Press
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- Peter Weill, 2004, "Don't just Lead, Govern: how top-performing firms govern IT", MISQ for executives
- IT Governance Institute, 2006, "Enterprise value: Governance of IT investments, Val IT Business case", IT Governance Institute, USA
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8.3.4 ΠΔ-340 - Quality Management and Best Practices

Code	**ΠΔ-340**
Title	*Quality Management and Best Practices*
ETCS	**7,5**
Semester	**A'**
Course Coordinator	**Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

Quality management in ICT concerns the design, construction, maintenance, and improvement of software, but also the way IT services are provided. Software quality management, therefore, is applied throughout its life cycle. In particular, software quality refers to two distinct but interrelated concepts: a) functional quality, i.e. to what extent the software meets its specifications and design, based on functional requirements, and b) its structural quality, i.e. its non-functional specifications, reliability, maintainability and sound construction. Functional quality is evaluated through testing procedures, and structural quality through automatic or manual analysis of its internal structure and source code. For all these requirements in quality management, numerous methodologies have been developed, standards have been established and best practices have evolved. to understand the advantages and disadvantages of each approach. Graduates will be able to rapidly design a quality management policy and will gain practical knowledge from the application of these practices in Greek companies.

After successfully completing the course, students will be able to:

- develop quality management strategies
- apply best quality management practices
- evaluate the performance of quality management strategies.

Syllabus

From chaos to systematic development

The evolution of software development from a quality perspective. The concept of best practice in software development.

The taxonomy of quality systems in the software life cycle

Systems and best practices for designing, developing, deploying, maintaining and supporting, and improving software.

The "mandatory" standards

ISO 9000, ISO/IEC 20000 (Information Service Delivery Management (ITSM) and ISO/IEC 27000 (Information Security Management System) families of standards. The flexibility to adapt good practices.

Quality in internal service provision

The ITIL methodologies. The basic principles and concepts of IT Service Management. The alignment of IT to the needs and goals of the organization and the continuous improvement of the services provided.

An organization's degrees of maturity in software production

CMM (Capability Maturity Model) methodologies and its evolution into CMMI (Capability Maturity Model integration). The five levels of maturity (from chaotic to optimized). Structure, function and the requirements they create in the organization.

Development models

Waterfall & V-model, models for the software life cycle, with an emphasis on control, advantages and disadvantages, Agile development and quality.

Automated auditing and monitoring tools

Towards a software 'factory', the importance of traceability of software operation.

Six Sigma

A general purpose quality methodology, applicable to ICT. How it affects the quality and culture of the organization.

The strategy of choosing quality systems, methodologies, and best practices

The road map to achieving quality and best practices. Alternative approaches. The establishment of the culture of quality in the organization.

Case study

Greek software companies. How they apply quality management throughout the software life cycle.

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Β' ΕΞΑΜΗΝΟ

8.3.5 ΠΔ-330 - IT Project Management

Code	**ΠΔ-330**
Title	*IT Project Management*
ETCS	**7,5**
Semester	**Β'**
Course Coordinator	**George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **George Vasilakopoulos, Emeritus Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

Digital project management is the core structure for planning and orchestrating the construction of digital technology projects, just as it is for any technology project. The management of a digital project refers to various phases and individual issues to be addressed with the ultimate goal of developing and operationalizing the project product (i.e., a digital system). Phases such as the initial economic and technical study of the project, the selection of the development process of the digital system (project product), the supervision (monitoring and control) of the construction of the project regarding the quality and progress of the physical object, the realization and commissioning of the digital system, as well as individual issues regarding staffing, costing, scheduling and the evaluation and control of project risks are included in the field of project management (especially digital projects). The course covers in depth the basic concepts of digital project management and focuses on the detailed description and use of digital project management best practices included in the Project Management Book of Knowledge (PMBOK) of the Project Management Institute – PMI) of the US. The main objective of the course is to provide students with the skills required to manage digital technology projects.

After successfully completing the course, students will be able to:

- design the economic and technical study of an information system
- develop an IT project management strategy
- analyze and evaluate costs and performance in developing an IT project

Syllabus

Characteristics of Digital Works

Success and failure of digital projects. Basic principles of project management. Digital project life cycles and digital systems development life cycles.

Conception and Launch of Digital Projects

Digital project management methodology (eg phases, deliverables, PMI project management processes). Development of business plans (e.g. measurable organizational value, feasibility study, risk analysis, cost-benefit study, financial performance measurement models).

Digital Projects Portfolio Creation Process

Project portfolio management (eg measuring organizational performance with the Balanced Scorecard metric).

Programming and Object Management of Digital Projects

Construction of charter and project management plan. Project management processes by PMI (project management knowledge areas and process groups). Project object management processes (eg initiation, definition, verification and control and monitoring

processes).

Task Analysis Structure and Digital Project Estimates

Task Breakdown Structure Development Process. Duration and resource consumption estimation methods (eg top-down method, bottom-up method, guess estimating method, Delphi method). Software technology metrics and approaches (eg Function Point Analysis, COCOMO).

Digital Project Timeline Development

Techniques and tools for project schedule estimation. Gantt charts. Network diagrams. CPM/PERT critical path method. Resource allocation and balancing.

Control and Monitoring of Digital Projects

Project performance analysis (eg variance analysis, value generated). Monitoring project performance indicators (eg SPI, CPI). Project completion forecast (eg projected project completion cost and projected cost to completion).

Managing Participation, Teamwork, Change and Conflict

Participatory management involving user groups. Project management teams. The group formation approach. Intergroup problem solving technique. Developing a strategy for change. Consequences and conflict resolution.

Cloud Computing Project Management

Characteristics of cloud computing. Choosing suitable cloud providers. Service Level Agreements. Danger management.

Big Data Analytics Project Management

Challenges in managing big data projects. Business value metrics of big data analytics. Initiate, plan, implement and monitor big data analytics projects. Success factors of big data projects.

Bibliography

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8.3.6 ΠΔ-350 - IT Acceptance and Adoption

Code	**ΠΔ-350**
Title	*IT Acceptance and Adoption*
ETCS	**7,5**
Semester	**Β'**
Course Coordinator	**Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Michael Filippakis, Professor,** Department of Digital Systems, University of Piraeus • **Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

The acceptance, adoption, development, implementation, and use of information technology are important research fields in the field of digital systems. But they are also special challenges for businesses and organizations. For the effective and efficient development of innovative digital systems, it is necessary to pay particular attention to the opportunities presented by digital technology and the challenges for its effective application.

This course aims to make graduates competent in the application of rules and methodologies regarding the acceptance and adoption of digital technology in organizations (and societies) as basic conditions for the successful development and implementation of digital systems. Thus, graduates will acquire the necessary knowledge to critically analyze business situations and problems and to understand the role of digital technology as part of their solution, to assess the competitive and business impacts of adopting innovative digital technology and to application of technologies of acceptance, adoption, evaluation, and use of digital systems.

After successfully completing the course, students will be able to:

- apply digital technology acceptance and adoption methodologies
- analyze business situations to reinforce the role of digital technology
- evaluate the role and effects of digital technologies in the development of digital systems and services.

Syllabus

Adoption of Digital Systems

Adoption of digital technology by organizations. Business Value Process Model. Categorization of conceptual mechanisms of adoption and use of digital technology (adoption/acceptance, initiation, appropriateness, diffusion, immediate use, improvised learning).

Digital Systems Success and Failure

Success/failure factors of digital systems. Factors influencing the success/failure of digital systems (technological, organizational, cultural, social, etc.).

Participatory Process of Systems Development

The principle of a coherent vision for digital change. The principle of genuine/active user participation in digital development. Mutual learning process. The principle of first-hand experience and work practices. Conflicts and dilemmas of developing digital systems. Phases of the participatory process. Professional training and exercise within the organization.

Acceptance Models of Digital systems

Theories and models of acceptance of digital technology (Reasoned Action, Technology

Acceptance Model (TAM) and extended TAM, Unified Theory of Acceptance and Use of Technology (UTAUT), Motivational Model, Theory of Planned Behavior). Adoption, Validation, Limitations and Extensions of the Model. Comparison between models.

Methodologies of Acceptance and Adoption of Digital Systems

Designing questionnaires (with structured and semi-structured questions). Quantitative and qualitative analysis of generated data. Information systems evaluation techniques. Ex-ante and ex-post evaluation of information systems.

Issues of adoption and use of digital systems

Systemic problems-obstacles to the widespread adoption and use of digital technology by organizations. Applying systems thinking to digital technology adoption.

Cloud Computing Adoption

Adoption of cloud computing strategies (maturity and evolution scale) Benefits operational KPIs (profit growth, digital budget allocation, digital cost and increased ability to respond to SLAs).

Health Information Systems Adoption

Adoption of medical and administrative health information systems. Adoption of new digital technologies in health care.

Mobile Digital Systems Adoption

Models of acceptance of mobile digital systems, Success of mobile digital systems, Usability of mobile digital systems, models for adoption and use of mobile digital systems.

Process Innovation Adoption

Factors influencing the adoption decisions of digital process innovation systems in organizations. Diffusion of innovation theory.

Adoption of Analytics

Critical success factors for the adoption of business analytics (Business Analytics Adoption) and big data analytics (Big Data Analytics Adoption). Healthcare Analytics Adoption Model.

Bibliography

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8.3.7 ΠΔ-360 - IT Costing and Procurement

Code	**ΠΔ-360**
Title	*IT Costing and Procurement*
ETCS	**7,5**
Semester	**Β'**
Course Coordinator	**Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Dimosthenis Kyriazis, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

A large percentage of projects fail due to incorrect costing. As the implementation of the project progresses, the available financial resources are exhausted with undesirable results for the development and completion of the project. The purpose of the course is to make the students who attend it competent in the preparation of integrated costing studies of digital systems.

After successfully completing the course, students will be able to:

- to analyze the cost of developing information systems
- to develop costing and return on investment studies in the development of information systems
- evaluate IT development plans in terms of cost and return on investment

Syllabus

Costing

Introduction, cost estimation process and its categories (pre-estimation, feasibility study, final estimation, costing), estimation accuracy, indirect costs, direct costs, personnel costs, out-sourcing costs, depreciation costs.

Costing methodologies and models

Wolverton model, Walston and Felix model, Bailey and Basili model, COCOMO, Machine Learning methods, Function Point Analysis (FPA).

Financial Feasibility Techniques: Business value, the context

Val IT principles, processes of Val IT, case study, internship. Cost benefit analysis (CBA), Time value for money, Net presence value (NPV) & Internal Rate of Return (IRR), Break Even Analysis, Return on investment (ROI), Payback period (PP).

Pre-award procurement phase

Call for Tender (Preparation, Publication, Notification), Tendering process, European Single Procurement Document (ESPD) and Virtual Company Dossier (VCD) for evidences, e-CERTIS mapping of qualification criteria for cross-border procurement.

Post-award procurement phase

eOrdering, eCatalogues, eInvoicing, new eInvoicing Directive.

Requirement Analysis

Identification of Business Processes, identification of key business processes and their correlation with business drivers, separation between strategic and cost requirements, costing of current processes, identification of key stakeholders and their influence on the priorities set, production of a requirements analysis document and its translation into solicitation document (RFP).

Contents of a notice issue

Organization description, system requirements, desired outcomes, measuring successful implementation, procurement requirements, schematic representations, architectures and definition of facility requirements, definition of desired technology, definition of

processes selected to be automated, call for submission of the appropriate software and functionality (matching the requirements, which are covered by standardized software and those to be covered by software, which should be developed specifically for the specific organization/business), implementation, transfer of know-how and training of users, available resources from the suppliers to the project and resources available from the company to the suppliers, schedule – implementation plan, selection criteria and grading, contractual and legal requirements, payment plan, acceptance procedures, transfer of project operation responsibility to the company and completion of the contract, additional services . Hardware costs, operating environment – installation requirements, software, supply options, maintenance contract requirements, SLAs and desired level of support, implementation within the project, additional costs outside the project budget, what services/facilities/facilities the organization/business will make available to suppliers.

Costing model

Procurement/purchasing conditions, Definition of an internal procurement strategy based either on the Commitment to Competitive pricing policy or in contrast to a procurement strategy based on long-term collaborations (frame agreements), Cost of differentiation, Basic Principles, Determination of Cost Factors, Productivity and cost – Man-Day Cost, Materials, Development vs. purchasing an off-the-shelf solution, Cost of administration, Design of specialized IT manufacturing and costing models, Total cost of ownership, Simple vs. Complex costing models, Defining criteria and cost segmentation, Internal cost of Ownership, Cost of Ownership with availability of resources from suppliers, Availability of resources on demand, Construction of cost tables at the level of process or product, Definition of minimum conditions and increase of costs according to the desired result, Triangulation of data with the aim of improving costing models.

Supplier selection

Sources of potential suppliers, evaluation and rating of suppliers, supplier selection, suppliers with long-term cooperation relationships, Due Diligence, key points of a contract and related issues, legal issues and issues related to international transactions/collaborations.

Bibliography

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8.3.8 ΠΔ-370 - Risk Management and Service Level Agreements (SLA)

Code	**ΠΔ-370**
Title	*Risk Management and Service Level Agreements (SLA)*
ETCS	**7,5**
Semester	**Β'**
Course Coordinator	**Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus
Instructors	• **Andriana Prentza, Professor,** Department of Digital Systems, University of Piraeus

Learning Outcomes

Digital systems risk management and digital technology service level contracts are major challenges for businesses and organizations as well as important research fields. The systematic study, analysis, evaluation, response, management, and monitoring of risks as well as the conclusion of effective service level agreements are important elements for the effective and successful development and operation of digital systems.

This course aims to make students competent in the application of methodologies and practices regarding the management of digital technology risks in organizations. It also aims to make students competent in the application of rules and practices of conclusion and implementation of service level agreements to the successful development and operation of digital systems. Thus, students will acquire all the necessary knowledge to critically analyse business situations and problems related to risk management and digital systems service contracts.

After successfully completing the course, students will be able to:

- apply best risk management methodologies in the application of digital technologies
- analyze business situations and problems in terms of risk management in the digital systems service level agreement
- evaluate risk management practices in the use of technologies and digital systems.

Syllabus

Risk Management (RM)

Definitions, importance of IS for the organization, types and structure of risks, areas of application of IS, IS of Digital Systems and Services (ISS), key components of ISS risks, threats, weaknesses and impact, risk identification techniques, risk management strategies, IS methodology – key stages life cycle, examples.

Threats, Vulnerabilities and Opportunities

Understanding and managing threats, vulnerabilities and opportunities, initiatives, standards and best practices, examples - exercises.

Identification and Analysis of Risks

Definition of resources and activities to be protected, risk identification: risk identification techniques, risk classification, risk register, Risk Analysis: qualitative, quantitative, semi-quantitative analysis, expected value, decision trees, Monte Carlo modeling-simulation, sensitivity analysis, Case study, examples - exercises.

Risk Assessment

Definition, elements of risk assessment, types of assessment, assessment challenges, best practices, choice of risk assessment methodology, identification of risk assessment resources and activities, examples-exercises.

Risk Management Plans and Strategies
Coping plans, avoidance, transfer, responsibility sharing, reduction-mitigation, acceptance, enhancement, exploitation, examples-exercises.
Creating a Digital Technology Risk Management Plan
Purpose, objectives, responsibilities, procedures, scheduling, Gantt Charts, Critical Path, examples-exercises.
Information Security Risk Analysis and Management
Risk analysis and management methodology according to ISO/IEC 27005 (2011), threats, vulnerabilities, valuation of information system goods, risk analysis and management methods (CRAMM, OCTAVE, SBA Scenario).
Risk analysis case study
The CRAMM risk analysis and management method in detail, software tool demonstration and case study presentation.
Information security as a digital technology success factor
User resistance, acceptance of security policies, security requirements and acceptance of information systems and digital services.
Practical application of risk management using software
Software tutorials, lab exercises and examples.
Service contracts
Definition, structure of service contracts, international initiatives and best practices, drawing up service contracts, examples-exercises.
Service contracts in practice
Practical application of creating and managing a contract for the provision of digital technology services.

Bibliography

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C' SEMESTER

8.3.9 ΠΔ-380 - Μεταπτυχιακή Διπλωματική Εργασία

Code	**ΠΔ-380**
Title	**Μεταπτυχιακή Διπλωματική Εργασία** *MSc Dissertation*
ETCS	**30**
Semester	**C'**
Course Coordinator	The director of the MSc program
Instructors	The Faculty Members of the MSc program

Learning Outcomes

The master thesis project aims to extend the student's academic skills, introduce them to a certain research area and potentially motivate them to continue their research work beyond the completion of their Master's Degree. This may be achieved not only by exploiting particular skills and knowledge acquired from taught courses but also by enhancing their ability to tackle a novel research area and/or problem.

In additions, it expands the student's professional skills by developing/improving their ability to research, manage/organise information, think creatively, pursue innovation and report adequately the findings of their research.

After successful completion of the thesis, students will be able to:

- search for appropriate bibliographic sources and summarize the findings of their study in a systematic way
- address difficult problems that include research aspects
- organize actions and take initiatives for project management
- design and develop original ideas in the wider field of information systems and services
- apply research methods, techniques and problem solving algorithms
- evaluate alternative solutions and choose the most suitable one
- communicate the results of the research work in the form of a technical report (thesis text) but also in the form of a presentation

Syllabus

In the third semester of the MSc program, students are expected to complete a postgraduate dissertation (PGD). The PGD should demonstrate advanced theoretical knowledge, practical skills, critical thinking, problem analysis and synthesis, as well as research capability of the student. It may address empirical, theoretical, or applied topics and may be carried out in collaboration with a private or public entity in Greece or abroad dealing with relevant subjects.

The instructors of the MSc program submit thematic areas for postgraduate dissertations, which are made available to the students on LEFKIPPOS. Students choose a thematic area and a supervising Faculty Member, and, with their consent, submit a relevant application to the Secretariat of the MSc program. The writing of the PGD can be done either in Greek or in English.

The examination of each PGD includes a brief presentation and demonstration of any systems developed within it, before the respective examination committee. The

examination committee evaluates the PGD on a specific form, which is signed by its members.

Guidelines for writing the postgraduate dissertation can be found at the following link: https://mscdss.ds.unipi.gr/en/ .

9 INFORMATIONS

For more information about the postgraduate program of studies, you can visit the following website: https://mscdss.ds.unipi.gr/en/ .