PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

MASTER'S DEGREE PROGRAM

Establishment	Faculty / Institute	Department
Mohamed Khider University - Biskra	Faculty of Exact, Natural and Life Sciences	Department of Computer Science

Domain: Mathematics-Computer Science

Field: Computer Science

Specialty: Information Systems, Optimization and Decision (SIOD)

Academic year: 2023/2024

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

مواءمة

عرض تكوين ماستر

أكاديمي

المؤسسة	الكلية/ المعهد	القسم
جامعة محمد خيضر - بسكرة	كلية العلوم الدقيقة و علوم الطبيعة و الحياة	قسم الإعلام الآلي

الميدان : رياضيات – إعلام آلي

الشعبة : إعلام آلي

التخصص : أنظمة المعلومات، الأمثلة واتخاذ القرار

السنة الجامعية: 2023/2024

SUMMARY

I – Master's Degree Identity
(All fields must be completed)

1 - Location of the training:

Faculty (or Institute):

Faculty of Exact Sciences, Natural and Life Sciences
Department of Computer Science

2- Training Partners*:

- Other Academic Institutions:

- Businesses and other socio-economic partners:

- International partners:

DOLPHIN team of the Laboratoire Informatique Fondamentale LIFL (University of Lille 1)- INRIA Lille, CNRS, France.

TINC-Net team of the Laboratory of Image, Signals and Intelligent Systems LISSI (Université Paris-Est de Créteil), France.

VORTEX team, Institut de Recherche en Informatique de Toulouse (Université Paul Sabatier de Toulouse, Université des Sciences Sociales de Toulouse and Institut Polytechnique de Toulouse, France.

* = Present the agreements as an appendix to the training

3 – Context and objectives of the training

A – Access conditions *(indicate the Bachelor's degree specialties that may give access to the Master's degree)*

In M1:

- Academic Bachelor's Degree in Computer Science
- A recognized equivalent title

In M2:

- M1 with basics in algorithms, databases, information systems, optimization and data analysis.
- (Application)

B - Objectives of the training (skills targeted, pedagogical knowledge acquired at the end of the training - maximum 20 lines)

This program aims to equip students with the necessary skills for designing, implementing, and administering information systems, as well as utilizing them to support decision-making.

In the first year (M1), students delve into both basic and advanced concepts of information systems and databases, thereby reinforcing the foundational knowledge acquired at the bachelor's level. Additionally, fundamental principles of optimization and data mining are covered. This initial year is designed to enable students to comprehend information systems, their structures, and operational mechanisms.

Moving into the second year (M2), the focus intensifies on data mining and optimization methods. This advanced coursework provides students with the essential tools to leverage the data accumulated by information systems, enhancing decision-making processes related to these systems.

This program offers students an opportunity to gain expertise in the fields of information systems, business intelligence, and optimization. Its objectives are to train students in:

- Designing information systems
- Administering databases
- Utilizing decision-making tools such as learning, classification, segmentation, associations, etc.
- Implementing optimization tools including heuristics, complexity, etc.

C – Targeted job profiles and skills *(in terms of professional integration) - maximum 20 lines):*

The master's degree focuses on three core concepts: Information Systems, Business Intelligence, and Optimization.

Information Systems: This concept aims to equip students with theoretical and practical tools to automate various daily tasks in fields such as administration, banking, and marketing. Given the societal shift towards e-governance, these skills are crucial to support and develop information systems across different sectors, serving as a software infrastructure for effective governance.

Business Intelligence: This concept prepares students with the skills needed to leverage data accumulated by various systems, enhancing the analysis of this data for improved decision-making.

Optimization: The notion of optimization is employed to devise efficient solutions in terms of computational time and storage locations. This approach is essential as we anticipate a surge in the number of information systems, the volume of exploited data, and the challenges posed by their heterogeneity and distribution. Efficient optimization is crucial for timely decision-making in this evolving landscape.

D- Regional and national employability potential of graduates

Graduates of this program are equipped to take on various roles, such as project manager, information system architect, project manager in the public or business sector, technical manager of studies-research-development in industry, or technical manager of scientific studies and fundamental research. They can also pursue careers as researchers, teacher-researchers, or research engineers in both public and private sectors (after obtaining a doctorate).

1. Research Master's Degree Objective:

The primary goal of the Research Master's degree is to prepare students for an LMD doctoral thesis. Upon receiving their Master's degree, students have the opportunity to join the LESIA research laboratory to pursue an LMD doctoral thesis. The completion of a Ph.D. opens up various possibilities, including:

- Opportunities in higher education and research institutions.
- Recruitment as teacher-researchers, with the potential to pursue university habilitation for access to the rank of authorized lecturer.
- Positions in public research institutions, including research organizations and higher education.
- Public Research Organizations: Examples include the LESIA Laboratory (Biskra), CDTA,CDER,etc

2. **The Research Master**'s degree will also give them the opportunity to work in the private research and development sector.

- The M2 year of the Research Master's degree can also be considered as a complement to specialized professional training, preparing for research and development careers in public and private administrations.

In addition, jobs in engineering functions can be targeted by this Master's degree, namely in:

- The consumer sector (computerization of administrations, data mining, large-scale data processing, optimization of decision-making processes);

- The creation, access and use of databases (all kinds: economic, medical, spatial, digital libraries), their coding and their dissemination (between sites and on the Internet).

- Decision support through process and prediction models in different sectors: administrative, business, industrial, research, etc.

- Algorithmic and decision-making tools: learning, decision support, prediction, optimization,

- Organizing and exploiting data: data analysis, querying, and mining

E – Gateways to other specialties

- To other Master's degrees with equivalent credits.

F – Training monitoring Indicators

In order to guarantee the quality of training in Information Systems, Optimization and Decision (SIOD), it is essential to meet current and future quality standards. For this reason, and in order to evaluate the performance of the curriculum, various mechanisms can be put in place to monitor and measure aspects such as the course of teaching, training programs, relations between students and teachers or the administration, the evolution of graduates and the opinions of economic partners on the quality of the courses provided and the graduates recruited. participation and success rate, etc. These evaluations can be carried out via surveys, follow-up of students in training, or surveys of recruited students and their employers, the use of the Progress platform, etc.

G – Supervisory capacity (give the number of students that can be accommodated)

30 students

4 – Moyens humains disponibles

A : Enseignants de l'établissement intervenant dans la spécialité :

Nom, prénom	Diplôme graduation + Spécialité	Diplôme Post graduation + Spécialité	Grade	Type d'intervention *	Emargement
Babahenini Mohamed Chaouki	Ingénieur informatique	Doctorat d'état : synthèse d'image	Prof	Cours + TD + TP + Encadrement	
Djeffal Abdelhamid	Ingénieur informatique	Habilitation : data mining	Prof	Cours + TD + TP + Encadrement	
Bitam Salim	Ingénieur informatique	Habilitation : Réseau et optimisation	Prof	Cours + TD + TP + Encadrement	
Bennaoui Hammadi	Ingénieur informatique	Habilitation : Génie logiciel	Prof	Cours + TD + TP + Encadrement	
Terisssa Sadek Labib	Ingénieur électronique	Habilitation : IA et image	Prof	Cours + TD + TP + Encadrement	
Rezeg Khaled	Ingénieur informatique	Habilitation : Systèmes d'information géographiques	Prof	Cours + TD + TP + Encadrement	
Kahloul Laid	Ingénieur informatique	Habilitation : Informatique	Prof	Cours + TD + TP + Encadrement	
Djerou Laila	Ingénieur informatique	Habilitation : Vie artificielle	Prof	Cours + TD+TP+ encadrement	
Slatnia Sihem	Ingénieur informatique	Habilitation : IA et Image	MCA	COURS + TD + TP + Encadrement	
Zerarka Mohamed Faouzi	Ingénieur informatique	Habilitation : Informatique	MCA	Cours + TD + TP + Encadrement	
Tibermacine Okba	Ingénieur informatique	Habilitation : Informatique	MCA	Cours + TD + TP + Encadrement	
Mokhtari Bilal	Master en Informatique	Habilitation : Informatique	MCA	Cours + TD + TP + Encadrement	
Bourekache Samir	Ingénieur informatique	Habilitation : Informatique	MCA	Cours + TD + TP +	

Nom, prénom	Diplôme graduation + Spécialité	Diplôme Post graduation + Spécialité	Grade	Type d'intervention *	Emargement
				Encadrement	
Sahraoui Somaya	Master en Informatique	Habilitation : Réseaux	MCA	Cours + TD+TP+ encadrement	
Meadi Mohamed Nadjib	Ingénieur informatique	Doctorat: Systèmes d'information	MCB	Cours + TD + TP + Encadrement	
Goumeida Abdelbasset	Ingénieur informatique	Doctorat nouvelle thèse : Bases de données	MCB	Cours + TD + TP + Encadrement	
Akrour Djouher	Master en informatique	Doctorat nouvelle thèse : Vie artificielle	MCB	Cours + TD+TP+ encadrement	
Bahi Naima	Ingénieur informatique	Doctorat nouvelle thèse : Vie artificielle	MCB	Cours + TD+TP+ encadrement	
Bentrah Ahlem	Master en Informatique	Doctorat : Synthèse d'image	MCB	Cours + TD + TP + Encadrement	
Aloui Ahmed	Ingénieur informatique	Doctorat en science: Génie Logiciel	MCB	Cours + TD+TP+ encadrement	
Touil Kelthoum	Ingénieur informatique	Magister : IA et Image	MAA	Cours + TD + TP + Encadrement	
Zouioueche Amina	Ingénieur informatique	Magister	MAA	Cours + TD+TP+ encadrement	
Bendahmane Toufik	Ingénieur informatique	Magister: Informatique	MAA	Cours + TD+TP+ encadrement	

* = Cours, TD, TP, Encadrement de stage, Encadrement de mémoire, autre (à préciser)

B: External Supervision:

Institution to which you are attached:

Surname, first name	Diploma Graduation + Specialty:	Post-Graduation Diploma + Specialty:	Rank	Type of intervention *	Sign-in

Institution to which you are attached:

Surname, first name	Diploma Graduation + Specialty:	Post-Graduation Diploma + Specialty:	Rank	Type of intervention *	Sign-in

Institution to which you are attached:

Surname, first name	Diploma Graduation + Specialty:	Post-Graduation Diploma + Specialty:	Rank	Type of intervention *	Sign-in

*** = Courses, tutorials, practical work, internship supervision, dissertation supervision, other (to be specified)**

5 – Specific material resources available

A- Pedagogical Laboratories and Equipment: Sheet of existing teaching equipment for the lab work of the planned training (1 sheet per laboratory)

Lab Name: Data Centre

Student capacity: 100

N°	Title of Equipment	Number	Comments
01	HP ProLiant ML370G5 SERVER * 2 quad-core Intel Xeon processors: .33 GHZ * RAM: 6 GB * HDD: 6x 140 GB * DAT Drive: HP Dat 72 USB. * TFT Screen + Keyboard	06	Local Area Networks + Permanent Internet Access Operating Systems. Windows/Linux
02	HP Thin Client Workstation: 19 Screen + Light Unit + Keyboard + Mouse	25	
03	PC HP Compaq dx 2300 dual core 1.8 ghz , RAM :1 GB ,D D :160 GB + Mouse + keyboard + 19" screen	25	
04	Dell proc dual core 1.80 Ghz Ram: 512 MB D.D: 80 GB	25	
05	PC: HP Compaq dx 2400 dual core RAM: 1 GB HDD: 160 GB 17" screen	10	
06	Network Cabinet 3000 VA UPS 2 MB ADSL Modem 24-Port Catalyst 2960 Switch	01 01 01 05	Local area network

Laboratory title: Machine room (02 rooms)

Student capacity: 25

N°	Title of Equipment	Number	Comments
01	PC + internet connection	25	

Lab Name: Network Lab

Student capacity: 25

N°	Title of Equipment	Number	Comments
01	Dell P4 PC 3.06 Ghz RAM: 512MB D.D: 80GB	20	
02	CISCO Laboratory (switch, training material)		

B- Terrains de stage et formation en entreprise :

Lieu du stage	Nombre d'étudiants	Durée du stage

C- Laboratoire(s) de recherche de soutien au master :

Chef du laboratoire : Prof. Babahenini Mohamed Chaouki
N° Agrément du laboratoire : N° 42 du 05 février 2001
Date :    بابا حنيني محمد شوقي مدير المخبر Avis du chef de laboratoire :
Avis favorable

D- Research project(s) in support of the master's degree:

Title of the research project	Project Code	Project Start Date	Project End Date
Machine Learning for Fraud Detection	C00L07UN070120220001	2022	2025
Predictive decision-making system for the improvement of agricultural production in the Arid	C00L07UN070120220009	2022	2025

E- Personal work and ICT spaces:

1. Videoconferencing Room: This room includes:
- An internet connection via a specialized line for the purpose of organizing video conferences.

2. Documentation Centre: This center contains all dissertations and theses defended from 2000 to 2016 (by means: 50 engineers, 200 master's degrees, 200 bachelor's degrees). The available versions are in paper and electronic versions.

3. Distance learning room: Internet room for end-of-studies students equipped with a specialized internet line (modem4MO). Two large screens with TVs.

II – Semester organization

(Please present the 4 semester sheets)

1- Semester 1:

Teaching Unit	HVS	H.V weekly				Coeff	Credits	Method of assessment	
	14-16 weeks	C	DS	LW	Other/ Work Staff			Continuous	Examination
Fundamental Unit									
FTU 1. Systems, architectures, and data mining	**168h**	**6h**	**1h30**	**4:30**	**4h**	**9**	**18**		
Distributed systems	63h	1h30	1h30	1h30	1h30	3	6	50%	50%
Introduction to Data Mining	63h	3h	-	1h30	1 hour	3	6	50%	50%
Communication Networks	42 hours	1h30	-	1h30	1h30	3	6	33%	67%
Methodological Unit									
MTU 1. Database and big data	**105h**	**3h**	**1h30**	**3h**	**2h**	**4**	**10**		
Big data	42 hours	1h30	-	1h30	1 hour	2	5	50%	50%
Foundations of database	63h	1h30	1h30	1h30	1 hour	2	5	50%	50%
Transversal Unit									
TTU 1. Management & English	**42 hours**	**3h**	**-**	**-**	**1h**	**2**	**2**		
English	9 h.	1h30	-	-	-	1	1		100%
Entrepreneurship	9 h	1h30	-	-	1h	1	1		100%
Total Semester 1	315h	12 h	3h	7:30	7h	**15**	**30**		

2- Semester 2:

Teaching Unit	HVS	H.V weekly				Coeff	Credits	Method of assessment	
	14-16 weeks	C	DS	LW	Other/ Personal work			Continuous	Examination
Fundamental TU									
FTU 2.1 Databases	**84h**	**3h**	**-**	**3h**	**2h**	**6**	**10**		
Advanced Databases	42 hours	1h30	-	1h30	1 hour	3	5	50%	50%
Database Architecture and Administration	42 hours	1h30	-	1h30	1 hour	3	5	50%	50%
FTU 2.2 Neural Networks and Cloud	**105h**	**3h**	**1h30**	**3h**	**2h**	**4**	**10**		
Neural Networks and Deep Learning	63h	1h30	1h30	1h30	1 hour	2	5	50%	50%
Cloud computing	42 hours	1h30	-	1h30	1 hour	2	5	50%	50%
Methodological Unit									
MTU 2. Analysis & Optimization	**105h**	**3h**	**3h**	**1h30**	**2h30**	**4**	**8**		
Complexity & Optimization	63h	1h30	1h30	1h30	1h30	2	4	50%	50%
Data analysis	42 hours	1h30	1h30	-	1 hour	2	4	33%	67%
Transversal TU									
TTU 2. Scientific research	**9h**	**1h30**	**-**	**-**	**1 hour**	**1**	**2**		
Research Methodology	9h	1h30	-	-	1 hour	1	2		100%
Total Semester 2	315h	10:30h	4:30h	7:30h	7:30h	15	**30**		

3- Semester 3:

Teaching Unit	HVS	H.V weekly				Coeff	Credits	Method of assessment	
	14-16 weeks	C	DS	LW	Other			Continuous	Examination
Fundamental Unit									
FTU 3. Business intelligence	**147h**	**4:30h**	**1h30**	**4:30 p.m.**	**3h**	**8**	**15**		
Advanced Data Mining	63h	1h30	1h30	1h30	1 hour	3	6	50%	50%
Data Warehouses & Data Preparation	42 hours	1h30	-	1h30	1 hour	3	5	50%	50%
Sequential Data Analysis	42 hours	1h30	-	1h30	1 hour	2	4	50%	50%
Methodological Unit									
MTU 3. Decision support and information systems	**126h**	**4:30h**	**3h**	**1h30**	**3h**	**6**	**13**		
Information Retrieval	42 hours	1h30	-	1h30	1 hour	2	4	50%	50%
Multi-criteria analysis for decision support	42 hours	1h30	1h30	-	1 hour	2	4	50%	50%
Web-based information systems	42 hours	1h30	1h30	-	1 hour	2	5	50%	50%
Transversal TU									
TTU 3. English	**9 h**	**1h30**	**-**	**-**	**-**	**1**	**2**		
English 2	9 h	1h30	-	-	-	1	2		100%
Total Semester 3	294h	10:30h	4:30h	6h	6h	15	**30**		

4- Semester 4:

Domain : Mathematics – Computer science
Program : Computer science
Specialty : Information Systems, Optimization and Decision (SIOD)

Internship in a company, culminating in a dissertation and defense, is a requirement. The S4 semester is dedicated to either an internship or an introductory research project, concluding with a dissertation and defense.

This version maintains the same information but streamlines the language for better flow.

	HVS	Coeff	Credits
Personal Work			
Internship in a company			
Seminars			
Other (specify) Project (dissertation + defense)	12 hours/week, i.e. 144 hours for the semester	15	30
Total Semester 4	144h	15	30

5- Overall summary of the training: (indicate the separate overall HV in progress, Directed Studies (DS), for the 04 semesters of teaching, for the different types of UE)

TU / VH	FTU	MTU	DTU	TTU	Total
Course	231	147	-	84	462
DS Directed Studies	63	105	-	-	168
LW Lab Work	210	84	-	-	291
Personal work	161	105	-	28	294
Other (specify) PFE	144	-	-	-	144
Total	648	441	-	112	1357
Credits	83	31	-	6	**120**
% in credits for each TU	69%	26 %	-	5%	100%

III - Detailed syllabus by course

(1 detailed sheet per course)

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*
TU Title: Systems, Architectures, and Data mining
Course Title: Distributed Systems
Credits: 6
Coefficients: 3

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

This course is devoted to the fundamental aspects of distributed systems and the problems involved in their design and implementation. Emphasis will be placed on ways to compensate for the lack of global time in asynchronous systems and on basic techniques for designing failure-resistant systems.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

In the undergraduate (bachelor's degree) program, students studied key concepts related to process, synchronization, and communication within centralized systems through two dedicated courses.

Content

I- Concept of competition.
- The different interpretations of competition.

II- Time and state in a distributed system.
- Causality and sequencing of events in a distributed system.
- The overall state of a distributed system; Consistent Cuts
  Applications: backup-resume algorithms, stable property detection.
- Global scheduling by logical clocks applications: mutual exclusion, distributed tail;
- Causal Ordering by Vector Clocks Applications: Observation, Focus;
- Synchronization of physical clocks

III- Distributed Process Cooperation
- Virtual ring, insertion protocols, withdrawal, fault management.
- Election algorithms: group management.
- Termination detection algorithms. Application: Distributed crumb tray.

IV- Fault tolerance
- Failure hypotheses.
- Specification of consistency: linearization, sequential consistency, causal consistency.

- Primary copy and active duplication.
- Reliable delivery algorithms and management of process groups.

V- Distributed Information Management

- Principles of distributed object management.
- Implementation: virtual memory, distributed objects.
- Large-scale dissemination.
- Cache management, duplication, consistency.
- Applications: P2P systems.

Assessment method: 50% Exam + 25% Lab work+ 25% Personal Work

References *(Books and handouts, websites, etc.).*

- R. Guerraoui, L. Rodrigues, Reliable Distributed Programming, Springer, 2006.
- Van Steen, Maarten, and Andrew S. Tanenbaum. Distributed systems. Leiden, The Netherlands: Maarten van Steen, 2017.
- A. S. Tanenbaum, M. van Steen, Distributed Systems - Principles & Paradigms, Prentice Hall, 2002.
- S. Mullender (editor), Distributed Systems, 2nd ed., Addison-Wesley, 1993.
- M. Singhal, N. G. Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill, 1994 .
- V. C. Barbosa, Introduction to Distributed Algorithms, MIT Press, 1996.
- C.A.R. Hoare, Communicating Sequential Process , Prentice Hall Intern. 2004.
- A. Silberschatz and J.L. Peterson, Operating System Concepts, Addison-Wesley, 1983.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*

Title of the unit: Systems, Architectures, and Data mining

Title of the course: Introduction to Data Mining

Credits: 6

Coefficients: 3

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

The course aims to introduce the field of data mining, serving as a foundation for the advanced data mining course in the M2 program. The objective is to develop the essential skills for analyzing problems, describing various data mining methods relevant to problem-solving, and mastering all necessary data preparation techniques. Through hands-on lab work using the Weka software, students will have the opportunity to assimilate the covered concepts effectively.

Recommended prior knowledge (brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

Mathematics and algorithms.

Content

Chap1: Introduction
- Definition and Goals of Data Mining
- Process of Data Mining
- Nature of the data to be analyzed
- Tasks of Data mining
- Areas of applications
- Integration into DBMS

Chap2: Data Preparation Techniques
- Data Description and Summary
- Data Cleansing
- Integration & Transformation Reduction
- Discretization

Chap3: Data Visualization
- Types of Visualization techniques
- Interactive Exploratory
- Visualization Tools

Chap4: Supervised Classification
- Supervised Classification
- Process Model Concept
- Validation Techniques

KPPV
Naïve Bayesian Classification
Combination of Models (Meta-Model)

Chap5: Unsupervised Classification
Definitions
K-Means Algorithm
Clustering Validation

Assessment method: 50% Exam + 50% LW

References (Books and handouts, websites, etc.).

- Mr. Kantardzic. Data mining: concepts, models, methods, and algorithms. Wiley- Interscience, Third Edition 2019.
- Tan, Steinbach & Kumar, Introduction to Data Mining, Pearson, 2019
- J. Han, M. Kamber, and J. Pei. Data mining: concepts and techniques. Morgan Kaufmann Pub, Third Edition 2012.
- Dorian Pyle, Data Preparation for Data Mining, Morgan Kaufmann Publishers 1999

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*

TU Title: Systems, Architectures, and Data mining

Course Title: Communication Networks

Credit: 6

Coefficients: 3

Teaching Objectives (*Describe what the student is expected to have acquired as* skills after success in this course – maximum 3 lines).

The objective of the Communication Networks course is to enable the student to:

- Understand and be able to implement the different devices and protocols used in wired and mobile networks.
- Design, configure, and manage wired and wireless networks with application.

Recommended prior knowledge (brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

Networks (3rd year), Distributed Systems.

Content

1- Link-layer callback
- Concurrent access to media, CSMA/CD protocol, etc.

2- The Network's Layers
- Reminder about the IPv4 protocol
- Routing in IP networks:
  * Distance Vector Routing Protocols
  * Link-state routing protocols.
- IPv6 protocols
- Managing the coexistence between IPv4 and IPv6 networks.
  * Coexistence based on tunneling.
  * Coexistence based on Gateways.

3- The Transport Layer
- TCP protocols
- The UDP protocol

4- Quality of Service (QoS) in IP Networks
- QoS settings
- Network factors that influence the QoS of communications.
- TCP/IP and QoS protocols

5- Introduction to Wireless Communication Networks
- Cellular Wireless Networks
- Ad Hoc Wireless Networks

Assessment

67% Exam + 33% Personal work.

References.

- Kurose, J. F., & Ross, K. W. (2021). Computer Networking A Top-Down Approach. Peasron Editions. 2021.
- Bonaventure, O., Networking: Principles, Protocols and Practice, 3rd Edition, 2021.
- Lannone, E., Telecommunication networks, O'Reilly Edition, 2017.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*

Title of the TU: Databases and Big Data

Title of the course: Big Data

Credits: 5

Coefficients: 2

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

Big data platforms deal with the processing and analysis of large amounts of data. The objective of this course is to allow students to acquire the basic skills related to this field and be able to manipulate systems dedicated to data collection and analysis at a large scale to extract knowledge.

Recommended prior knowledge (brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

No special knowledge is required, but a basic understanding of machine learning and databases will be beneficial.

Content

- Introduction to Big Data: Definitions, Benefits, Challenges and Solutions.
- Data types (graph, structured and unstructured, operational, and non-operational, audio, image, natural language, etc.).
- The main characteristics of big data (The 5v's).
- Key Steps: Purpose, Data Collection and Preparation, Storage, Analysis and Modeling, Knowledge Extraction.
- Visualization of big data.
- Application Fields
- Tools for developing the Lab work: MongoDB/ Haddop/ Oracle, etc.

Assessment method: 50% Exam + 50% LW

References (Books and handouts, websites, etc.).

- Jared Dean, Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Willey, 2014.
- Francesco Corea, An introduction to data, Springer, 2019.
- Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Introducing data science, 2016.
- David Dietrich, Barry Heller, Beibei Yang, Data Science & Big Data Analytics, Illey, 2015.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*
TU title: Databases and Big Data
Course Title: Foundations of database
Credits: 5
Coefficients: 2

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

Acquire the necessary theoretical and practical knowledge to implement a relational database and manipulate its data.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Content

Chapter 1: Introduction and reminders
Chapter 2: Relational Algebra
Chapter 3: SQL: Data Storage and Manipulation
- Defining Storage
- Structures Implementing
- Integrity Constraints
- Manipulation: inserting, deleting, and updating data

Chapter 4: SQL: Querying Databases
- Projection
- Restriction
- Grouping
- Joins
- Set Operators Group
- Functions Nested
- Queries Views

Chapter 5: Procedural and Event Programming Functions
- Triggering
- Procedures

Assessment

50% Exam + 25% DS + 25% LW.

References.

- Jérôme Gabillaud, SQL and relational algebra: basic concepts, Eni edition, 2008
- Elmasri, R. (2021). Fundamentals of database systems seventh edition
- Learn SQL with Mysql with 40 corrected exercises Christian Soutou Edition Eyrolles

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*
Title of TU: Management and English
Course title: English 1
Credits: 1
Coefficients: 1

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

Enables students to learn how to read, understand, and write reports, articles, computer texts, and to present their work in English.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

A technical English module was completed during the undergraduate bachelor's degree.

Content

Assessment

100% Exam.

References.

Any reference deemed useful.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S1*

Title of the TU: Management and English

Title of the Course: Entrepreneurship

Credits: 1

Coefficients: 1

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

This course aims to provide students with the tools for successful entrepreneurship and business creation. It serves as an introduction to the world of small and medium-sized enterprises (MSEs).

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Content

1. Entrepreneurship Context: (entrepreneurial traits, conducive characteristics, various forms of entrepreneurship, etc.)
2. Market Research: (analysis of competitors' existing offerings, etc.)
3. Synthesis of Market Knowledge and Target Selection.
4. Business Plan: (formalization from idea to project, analysis of the business creation process and approach)
5. Strategic Positioning of the Offer.
6. Marketing Mix.
7. Introduction to Human Resources Management and Stakeholder Relationship Management (customers, bankers, government, etc.).
8. Innovation and Strategies for New Business Development.

Assessment: 100% Exam

References *(Books and handouts, websites, etc.).*

1. Tixier D., Mathe H. and Colin J., La logistique d'entreprise - vers un management plus competitive, Dunod (Gestion Sup), 1998.
2. Cohen R., Designing and Launching a Project, Eyrolles (Editions d'Organisation), 2006.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*
TU title: Databases
Course Title: Advanced Databases
Credits: 5
Coefficients: 3

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

This course allows the students to discover the different aspects related to new trends in the field of databases management:

- Knowledge of object-oriented databases and OODB
- Knowledge of Distributed Databases
- Mobile Database

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Database Foundations (S1)

Content

Chapter 1: Introduction to Purpose-Oriented Databases

Chapter 2: Oriented DBMs

Chapter 3: OB: Standards and Systems

Chapter 4: Introduction to Distributed DBs

Chapter 5: Distributed OODB: Advanced Concepts

Chapter 6 : Oracle NoSQL

Assessment

50% Exam + 50% LW.

References.

- Omran A. Bukhres, Ahmed K. Elmagarmid : Object Oriented Multidatabase Systems : A solution for advanced applications Prentice Hall 1996
- Thomas Connolly, Carolyn Begg: Database Systems: A Practical Approach to Design, Implementation, and Administration, Eyrolles 2005
- Kumar, Interscience mobile database Systems, Wiley 2006*
- Elmasri, R. Fundamentals of database systems seventh edition, (2021).

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*
TU title: Databases
Course Title: Database Architecture and Administration
Credits: 5
Coefficients: 3

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

Understand the architecture of a Database Management System (DBMS) and how it efficiently manages a database. Acquire the skills and knowledge required for a Database Administrator.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Content

Chapter 1: Database Architecture

Chapter 2: Installing the Database Management System

Chapter 3: Creating and Configuring a Database

Chapter 4: Managing Database Storage Structures

Chapter 5: Administering User Security

Chapter 6: Managing Concurrency Data

Chapter 7: Database Backup and Restore

Chapter 8: Performance Management

Assessment

50% exam, 50% LW

References.

- Ramez Elmasri, Sham Navathe, Database Design and Architecture, Pearson Education, 2004 - 728 pages.
- By Anupama Chowdhary, database management systems, education publishing, 2018.
- Oracle 9i Administration, ENI, 2002.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*

TU title: Neural networks and the cloud

Course Title: Neural Networks and Deep Learning

Credits: 5

Coefficients: 2

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

The objective of the course is to introduce the paradigm of artificial Neural networks. The course begins with the principles of the perceptron, then progresses to multi-layered and recurrent Neural networks, concluding with convolution networks and deep learning. Through practical exercises, students are guided to master the use of deep learning techniques and apply them in their respective fields of expertise.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Mathematics and algorithms.

Content.

Chapter 1 - Predictors and Linear Classifiers

- Linear Predictor and Classifier
- Train a Linear Predictor/Classifier
- Moderation
- Nonlinear Classifiers

Chapter 2 – Neural Networks

- The Formal Neuron
- Data propagation in Multi-layer Perceptron networks
- Error back propagation
- Synaptic weight adjustment (training)

Chapter 3 – Programming a Neural Network

- Creation and Initialization
- Data Propagation
- Back propagation

Chapter 4 – Deep Learning

- What is Deep Learning?
- Automatic Feature Extraction

Advances in Deep Learning Convolutions and Convolutional Networks

Applications of Deep Learning

Chapter 5 – Deep Learning

Programming Libraries

Application in each master's degree offer

Assessment

50% Exam + 25% DS + 25% LW.

References.

- Jean-Claude HTUdin, Understanding DEEP LEARNING: An Introduction to NTUral Networks, Science-eBook, second edition: December 2016.
- Aurélien Géron, Deep Learning with Keras and TensorFlow - 2nd edition, DUNOD, 2020
- John Paul Mueller, Luca Massaron, Deep Learning For Dummies, Learning made easy, 2019
- Antoine Cornuéjols, Laurent Miclet and Vincent Barra, Machine Learning: Concepts and Algorithms, 3rd edition, Eyrolles, 2018

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*

TU Title: Neural Networks and the Cloud

Course Title: Cloud Computing

Credits: 5

Coefficients: 2

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

Cloud computing is a network of centralized systems (data centers) that facilitate the storage, delivery, and transportation of various types of data from different applications via the Internet. Servers (data centers) are interconnected, exchanging both data and applications. The objective of this course is to familiarize students with the utilization of cloud infrastructures.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

No prior knowledge is required to follow this course.

Content

- Introduction.
- Notions of distributed computing and cloud.
- Key properties and features of cloud computing.
- Type of services and deployment (IaaS, PaaS, SaaS), private/public, etc.
- Components of the cloud.
- The applications of cloud computing in the field of Big Data.
- Cloud database management systems: resources, software, information, etc.
- Organizing data in the cloud.
- MongoDB: Server installation and launch, administration, deployment of MongoDB in the cloud, etc.

Assessment

50% Exam + 50% LW.

References.

- Cyrus Dasadia, Amol Nayak, MonoDB Cookbook, Packt Publishing, 2016.
- John W. Rittinghouse James F. RansomeCloud, Computing Implementation, Management, and Security, CRC press, 2010.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*
TU title: Analysis and Optimization
Course Title: Complexity and Optimization
Credits: 4
Coefficients: 2

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

This course enables students to enhance their understanding of algorithms acquired in the second year of the bachelor's degree, particularly exploring solutions for NP-Complete problems.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Notions of algorithmic.

Content

1. Fundamentals: Algorithms and Complexity
    - The Basics of Algorithm Analysis
    - Complexity of an algorithm
        - The performance of the algorithm
        - The Problem-Solving Strategy
        - Landau Concepts
    - Class and complexity of a problem: P, NP, PSPACE, EXPTIME
2. Recursion and the Divide and Conquer Algorithm
    - Sorting Algorithm Analysis
    - Search Algorithm
    - Graph algorithm
    - Tree Algorithm
3. Optimization Methods for problem Solving.
    - Definition of optimization
    - Combinatorial optimization
        - Exact methods: Branch and bound
        - Approximate methods:
            - Specialized heuristics: gluttonous algorithm, hill climbing.
            - Meta heuristics

4. Meta-heuristics and Evolutionary Algorithms
    - Single solution meta-heuristic, trajectory methods
        - Local Search Algorithm
        - Search Algorithm with Taboo
        - Simulated Annealing search algorithm.
    - Solution-based Population-Based Algorithms, Evolutionary Algorithms
        - Genetic algorithms

Assessment

50% Exam + 25% DS + 25% Personal Work.

References.

- Cormen, Leiserson, Rivest, Stein. Introduction to algorithms. Second edition, Dunod, 2002.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*
Title of the TU: Analysis and optimization
Course title: Data analysis
Credits: 4
Coefficients: 2

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

This course focuses on fundamental aspects of data analysis, including PCA, CFL, CM, etc., and incorporates practical data processing and the application of various analysis methods.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Notions of linear algebra, statistics, and probability. In the bachelor's degree cycle of the LMD program, students took courses devoted to these concepts.

Content

1. Introduction.
2. Importance of data analytics.
3. Single and multiple linear models.
4. Types of data analysis methods: Analysis of variance.
   Dimension Reduction Analysis: Principal Component Analysis (PCA).
   Qualitative and quantitative data analysis
   Factor analyses of single (CFA) and multiple (MCA) correspondences.
   Discriminant analysis.
   Descriptive Analytics
   Exploratory Analytics
   Predictive Analytics
5. Lab work: Sales analysis, investment analysis, price/profit analysis, etc.

Assessment:
67% Exam + 33% DS

References:

1. Benzécri, J.-P., & Coll., (1980). Data Analysis, Volume 1: Taxonomy, Dunod
2. Benzécri, J.-P., & Coll., (1980). Data Analysis, Volume 2: Correspondence Analysis, Dunod
3. Benzécri, J.-P., Benzécri F., (1980). Data Analysis Practice, Volume 1: Correspondence Analysis. Elementary Lecture, Dunod
4. Benzécri, J.-P., & Coll., (1981). Pratique de l'analyse des données, Volume 3: Linguistique et lexicologie, Dunod
5. Benzécri, J.-P., (1982). History and Prehistory of Data Analysis, Dunod
6. Benzécri, J.-P., & Coll., (1986). Pratique de l'analyse des données, Tome 5: Economie, Dunod

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S2*

TU title: Scientific research

Course Title: Research Methodology

Credits: 2

Coefficients: 1

Teaching Objectives (Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).

The objectives of the research methodology course are to assist students in developing the skills necessary to write comprehensive reports, with a specific focus on documenting their professional mission and master's thesis during semester 4.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

No knowledge is required.

Content

1. Concepts of Scientific Research Methodology

2. Research question formulation and research design

3. Critical review of the literature

4. Scientific Research Methods: Quantitative and qualitative methods

5. Analysis, interpretation, and reporting of research results

6. Writing and presenting a research project

Assessment. Exam 100%

References

- Blaxter, L. Hughes, C. & Tight, M. (1998) How to Research *Buckingham: Open University Press*
- Denscombe, M. (2002) Ground Rules for Good Research *Maidenhead: Open University Press*

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S3*
Title of the TU: Business Intelligence
Course Title: Advanced Data Mining
Credits: 6
Coefficients: 3

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

This course builds upon the concepts introduced in the IDM (Introduction to Data Mining) course taken during the M1. The goal is to empower students to master techniques for extracting various types of knowledge, including frequent patterns, prediction models, and descriptive models, using the Weka software introduced in Master 1. Emphasis will be placed on the application of these techniques for analyzing large datasets, with a focus on optimizing their implementation in programming.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Introduction to data mining as seen in M1.

Content

1. Frequent patterns, correlations, and association rules
    - 1.1 Basic Concepts
    - 1.2 Efficient methods for finding frequent patterns (Appriori, FP-growth, etc.)
    - 1.3 Types of Patterns
    - 1.4 Association rules
    - 1.5 Rare Patterns
2. Supervised Classification
    - 2.1 Basic Concepts
    - 2.2 Classification by Analysis of Association Rules
    - 2.4 Decision Trees
    - 2.5 Baise Naïve and Bayesian Networks
    - 2.6 Support Vector Machines SVM
3. Regression
    - 3.1 Definitions
    - 3.2 Simple Linear Regression
    - 3.3 Multiple Linear Regression
    - 3.4 Decision Tree Regression
    - 3.5 SVM for Regression (SVR)
4. Clustering
    - 4.1 Introduction and reminders
    - 4.2 Similarity measures
    - 4.3 Hierarchical clustering

4.4 Partitioned clustering
4.5 Incremental clustering
4.6 Density-based clustering
4.7 Support Vector Clustering (SVC)

Assessment method: 50% Exam + 25% DS + 25% LW

References *(Books and handouts, websites, etc.).*

- J. Han, M. Kamber, and J. Pei. Data mining: concepts and techniques. Morgan Kaufmann Pub, 2012.
- Mr. Kantardzic. Data mining: concepts, models, methods, and algorithms. Wiley- Interscience, 2019.
- Aggarwal, Data Mining: The Textbook, Springer Edition 2015.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: ***S3***
TU title: Business Intelligence
Course Title: Data Warehouses and Data Preparation
Credits: 5
Coefficients: 3

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

Currently, data warehouses serve as the most effective solution for integrating, storing, and retrieving a vast amount of information from diverse sources, constituting the static component (recording) of decision-making information systems. The aim of this course is to furnish essential fundamentals for designing, modeling, implementing, and maintaining data warehouses within an information system for decision support. Moreover, the course facilitates learning techniques for data preparation and integration, enabling students to manage a data warehouse with information sourced from a variety of heterogeneous data.

Recommended prior knowledge (brief *description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Knowledge of databases and information systems.

Content

1. Getting Started with Data Warehouses
    - From Information Systems to Decision-Making Information Systems
    - Motivations
    - Defining a Data Warehouse
    - Properties of a data warehouse
    - Purposes and Functions of a Data Warehouse
2. Data Warehouse Architecture
    - Data Warehouse Architecture
    - Warehouse/Store Duality
    - Metadata and data quality
    - The flow of data in a warehouse
    - OLAP and OLLW: Definition, Properties, Operation, and Comparison
3. Data Extraction and Integration
    - Integration of source diagrams
        - Virtualized Integration (Mediation: GAV and LAV Approaches)
        - Materialized integration (the data warehouse)
    - The ETL Process
        - Data extraction
        - Data Cleansing
        - Loading data

4. Warehouse Modeling
    - The multidimensional model
        - General Modeling Approach
        - Table of Facts
        - Dimension Tables
    - The Schemas of a Multidimensional Model
        - The star diagram.
        - The snowflake patterns.
        - The Constellation Diagram
        - Case study
5. Optimizing Physical Data Placements
    - Dedicated Operators
    - Optimization of join and aggregate operators
    - Materializations of views
    - Choice of storage media
6. Querying Data Warehouses
    - Data warehouse management systems (DBMS for BI, etc.)
    - Multidimensionnel queries (complexe SQL, etc.)

Assessment: 50% Exam + 25% Lab Work + 25% Personal Work

References *(Books and handouts, websites, etc.).*

Course materials available. They will be posted online at the beginning of the lessons.

- Multidimensional Databases and Data Warehousing, Christian S. Jensen, Torben Bach Pedersen, Christian Thomsen, Morgan & Claypool Publishers, 2010.
- Data Warehouse Design: Modern Principles and Methodologies, Golfarelli and Rizzi, McGraw-Hill, 2009.
- Advanced Data Warehouse Design: From Conventional to Spatial and Temporal Applications, Elzbieta Malinowski, Esteban Zimányi, Springer, 2008.
- The Data Warehouse Lifecycle Toolkit, Kimball et al., Wiley 1998.
- The Data Warehouse Toolkit, 2nd ed., Kimball and Ross, Wiley, 2002.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S3*
TU title: Business Intelligence
Course Title: Sequential Data Analysis
Credits: 4
Coefficients: 2

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

The course aims to familiarize students with the concepts and challenges inherent to categorical sequential data, encompassing their representation and analysis. The applications span various domains, including behavior analysis on the internet, marketing, banking, and more. Additionally, the course explores the analysis of biological data (DNA, protein, etc.) and meteorological data. Diverse analysis methods are covered, ranging from algorithms for extracting frequent sequential patterns to the search for discriminant subsequences.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Mathematics and Algorithms

Content

Chapter 1: Introduction
- Concepts and Definition
- Areas of Application
- Types of Sequences

Chapter 2: Mining Time Series
- Definitions
- Finding Similarity in Time Series Analysis

Chapter 3: Sequential Pattern Mining in Transactional Databases
- Sequential Pattern Mining: Basic Concepts
- Scalable Methods for Sequential Pattern Mining
- Sequential Patterns Under Constraints
- Periodicity Analysis for Temporal Sequential Data

Chapter 4: Sequential Pattern Mining for Biological Data
- Alignment of biological sequences
- HMM for Biological Sequence Analysis

Assessment: 50% Exam + 50% DS

References *(Books and handouts, websites, etc.).*

J. Han, M. Kamber, and J. Pei. Data mining: concepts and techniques. Morgan Kaufmann Pub, 2011.

Al-Naymat, Ghazi, New Methods for Mining Sequential and Time Series Dat, Vdm Verlag, 2010.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S3*
Title of the TU: Decision support and information systems
Title of course: Information retrieval.
Credits: 4
Coefficients: 2

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

This course is an introduction to the field of information retrieval which aims to answer the following question:

How can we automatically and quickly find the relevant information, for a particular need, from a large amount of information?

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Algorithmic

Content

1. Introduction
2. Indexing for Information Retrieval
3. Manual vs. Automatic Indexing
4. Information Retrieval Models
5. Rephrasing queries
6. Evaluation of Information retrieval
7. Information Retrieval on the WEB

Assessment
50% Exam + 25% Lab + 25% Personal Work

References:

- W. Bruce Croft, Donald Metzler, Trevor Strohman. 2009. Search Engines: Information Retrieval in Practice, Pearson Education
- Charles L. A. Clarke, Gordon V. Cormack, and Stefan Büttcher *Information Retrieval: Implementing and Evaluating Search Engines*. MIT Press, 2010.
- Christopher D. Manning, Prabhakar Raghavan and Hinrich, 2008.Introduction to Information Retrieval, Cambridge University Press.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S3*
Title of the unit: Decision support and information systems
Title of the course: Multi-criteria analysis for decision support
Credits: 4
Coefficients: 2

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

This course aims to cultivate in students the abilities to address real-world decision challenges characterized by the multitude of objectives and uncertainty. It is dedicated, on one hand, to the fundamental aspects of optimizing multi-objective problems and, on the other hand, to the aspects of uncertainty inherent in qualifying real phenomena.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Single-objective optimization, meta-heuristics, evolutionary algorithms, statistical tools. In Undergraduate Bachelor Cycle, students took two courses devoted to these concepts.

Content

1. Introduction of the decision in uncertainty
2. Multi-Objective Optimization.
3. Classical methods.
4. Approximate Algorithms
5. Performance Metrics and Testing Issues
6. Bandit problems,
7. Markov decision-making processes,
8. Known Environment: Dynamic Programming Algorithms
9. Unknown Environment: Reinforcement Learning

Assessment

50% Exam + 25% DS + 25% Personal Work

References:

- X. GandiblTUx, A. Jaszkiewicz, A. Fréville and R. Slowinski, guest editors. Special issue "Multiple Objective MetaHTUristics". Journal of HTUristics 6(3), 2000.
- K. Deb. Multi-Objective Optimization Using Evolutionary Algorithms, Wiley, 2001.
- M. Ehrgott and X. GandiblTUx, editors. Multiple Criteria Optimization: State of the Art Annotated Bibliographic Survey, volume 52 of International Series in Operations Research and Management Science. 496 pages. Kluwer Academic Publishers, Boston, 2002.
- El-Ghazali Talbi, MetahTUristics in Uncertain Environments, Wiley Edition, 2013.
- Chi-Keong Goh and Kay Chen Tan, Evolutionary Multi-objective Optimization in Uncertain Environments: Issues and Algorithms, springer, 2010.
- Enrique Alba, Amir Nakib and Patrick Siarry, MetahTUristics for Dynamic Optimization, Springer, 2012.

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S3*
Title of the TU: Decision support and information systems
Title of course: Web Information Systems
Credits: 5
Coefficients: 2

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

The objective is to instruct students in the utilization of Internet-based technologies for designing and developing web information systems (WIS). To achieve this, the course will delve into the methods, techniques, and tools of the Internet, Intranet, and Extranet as implemented in WISs. The study will extend to web architectures essential for WIS deployment and technologies facilitating the integration of companies' information systems with the external environment. Additionally, the course will cover the administration and security aspects of WISs.

Recommended prior knowledge (*brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Have completed the information systems course taught at the undergraduate bachelor's cycle.

Content

1. Introduction to Web Information Systems
2. General information about UML
3. Functional Requirements Modeling
    - Use Case Diagram
    - Activity Diagram
4. Content Modeling
    - Class Diagram
    - State Diagram
5. Navigation Modeling
    - Diagram of the navigation structure
    - Access Diagram
6. Presentation Modeling
    - Static model
    - Dynamic model
7. Adaptation Modelling
8. Security of web information systems

Development tools and platforms: PHP/MySQL, XML, J2EEn .Net, CMS.

Assessment: 50% Exam + 50% DS

References *(Books and handouts, websites, etc.).*

- Ni, Weiwei, et al., eds. Web Information Systems and Applications: 16th International Conference, WISA 2019, Qingdao, China, September 20-22, 2019, Proceedings. Vol. 11817. Springer Nature, 2019.
- De Klaus-Dieter Schewe, Bernhard Thalheim, Design and Development of Web Information Systems, Springer, 2019
- VIDGEN, Richard. Developing web information systems: from strategy to implementation. Elsevier, 2002.
- Kshetri, Nir. Cybersecurity Management: An Organizational and Strategic Approach. University of Toronto Press, 2021.
- Singer, Peter W., and Allan Friedman. Cybersecurity: What everyone needs to know. OUP USA, 2014.
- David Taniar, Johanna W. Rahayu, Web Information Systems, Idea Group Publishing 2004
- PRACTICE OF MySQL AND PHP Design and production of dynamic websites
  Philippe Rigaux Edition DONOD

Master's Degree: Information Systems, Optimization and Decision Making

Semester: *S3*
Title of the unit: English and Scientific Research
Course title: Scientific Research
Credits: 2
Coefficients: 1

Teaching Objectives (*Describe what skills the student is expected to have acquired after successful completion of this course – maximum 3 lines).*

The objectives of the course are to equip students with the necessary tools for writing comprehensive reports, with a specific focus on documenting their professional mission and master's thesis during semester 4.

Recommended prior knowledge (brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

Content

1. Concepts of Scientific Research Methodology
2. Research question formulation and research design
3. Critical review of the literature
4. Scientific Research Methods: Quantitative and qualitative methods
5. Analysis, interpretation, and reporting of research results
6. Writing and presenting a research project

Assessment

100% Exam

References *(Books and handouts, websites, etc.).*

Course materials available. They will be posted online at the beginning of the lessons.

- Blaxter, L. Hughes, C. & Tight, M. (1998) How to Research Buckingham: Open University Press
- Denscombe, M. (2002) Ground Rules for Good Research Maidenhead: Open University Press

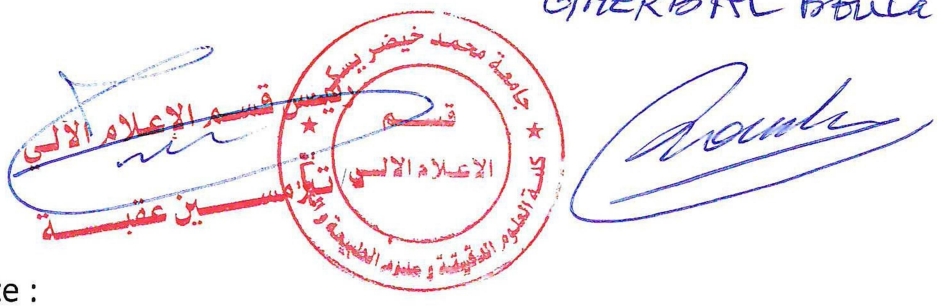
Comité Scientifique de département
Avis et visa du Comité Scientifique : Date :

Conseil Scientifique de la Faculté (ou de l'institut)
Avis et visa du Conseil Scientifique : Date :

Conseil Scientifique de l'Université (ou du Centre Universitaire)
Avis et visa du Conseil Scientifique : Date :

VII - Avis et Visas des organes administratifs et consultatifs

Intitulé du Master : Système d'Information, Optimisation et Décision

Chef de Département + Responsable du Domaine
Avis et Visa : GHERBAL Boulakhras  Date :
Doyen de la Faculté (ou Directeur de l'institut)
Avis et Visa :  2023 جانفي 29 Date :
Chef d'établissement Universitaire
Avis et Visa :  Date :

VIII - Endorsement of the Regional Conference

(Only to be filled in in the **final version** of the training offer)

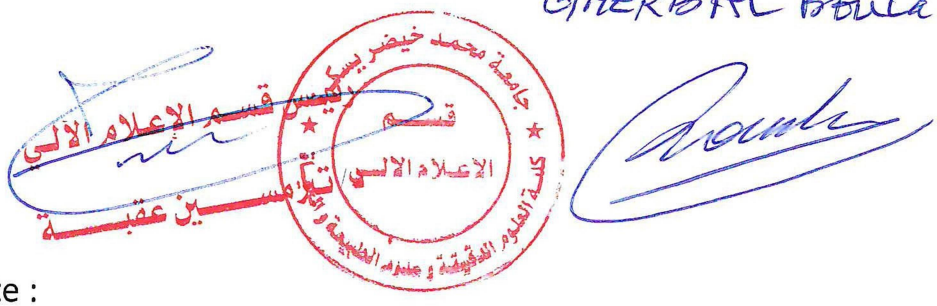
Comité Scientifique de département
Avis et visa du Comité Scientifique : Date :

Conseil Scientifique de la Faculté (ou de l'institut)
Avis et visa du Conseil Scientifique : Date :

Conseil Scientifique de l'Université (ou du Centre Universitaire)
Avis et visa du Conseil Scientifique : Date :

VII - Avis et Visas des organes administratifs et consultatifs

Intitulé du Master : Système d'Information, Optimisation et Décision

Chef de Département + Responsable du Domaine
Avis et Visa : GHERBAL Boulakhras  Date :
Doyen de la Faculté (ou Directeur de l'institut)
Avis et Visa :  2023 جانفي 29 Date :
Chef d'établissement Universitaire
Avis et Visa :  Date :

VIII - Endorsement of the Regional Conference

(Only to be filled in in the **final version** of the training offer)