DeCAIR Course Syllabus Form

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WP Number & Title	Work Package 5: Improving Existing M.Sc. Programs in Jordan and Lebanon by Implementing or Including AI and Robotics Courses		
Activity Number & Title	Task 5.1: Developing syllabi and content for added/modified courses in existing master programs in universities of partner countries		
WP Leader	Peter Eberhard, University of Stuttgart		
Due Date of Delivery	30/11/2021	**Project Month**	M11
Submission Date	14/9/2021	**Project Month**	M9

Revision History

Version	Date	Author	Description	Action *	Page(s)
1	1/8/2021	Clovis Francis	Master RSI Updated Courses Syllabus	C	1-6
2	22/10/2021	Clovis Francis	Version 2	U	
3	11/11/2021	Clovis Francis	Version 3	U	
4					

(*) Action: C = Creation, I = Insert, U = Update, R = Replace, D = Delete

Disclaimer

This project has been co-funded by the Erasmus+ Programme of the European Union.

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<table>
<tr><td>Course title</td><td>Introduction to Data mining and Machine Learning</td></tr>
<tr><td>Course number</td><td>RSI02</td></tr>
<tr><td>Credit hours (lecture and lab)</td><td></td></tr>
<tr><td>ECTS (weekly contact and self-study load)</td><td>4 (24 hours of total contact hours)</td></tr>
<tr><td>Prerequisites/co-requisites</td><td>Statistics (MATH 211)</td></tr>
<tr><td>Prerequisites by topic</td><td>Students are assumed to have good background in mathematics, particularly, calculus, linear algebra, statistics, and probability. Additionally, the students should have good programming skills, preferably, using Python.</td></tr>
<tr><td>Level and type (compulsory, elective)</td><td>Masters' compulsory course</td></tr>
<tr><td>Year of study and semester</td><td>Year 2, first semester</td></tr>
<tr><td>Description</td><td>This course provides an introduction of basic concepts of decision theory and data mining and to present machine learning methods and implementation techniques. It gives an overview over various types of data (for example sensor data, images, tables, text, graphs) and its properties. The covered topics include data preprocessing and preparation (for example normalization, PCA), introduction to classification and regression methods and model selection, Kernel based methods for classification and regression (SVM, KFD…), basics of unsupervised learning and introduction to clustering (representative based clustering and hierarchical clustering), Introduction to neural network for regression and classification, association rules and Recommendation systems.</td></tr>
<tr><td>Objectives</td><td>1. Introduce students to the basic concepts of decision theory and data mining.
2. Introduce students to the different classification and regression methods and model selection, Kernel based methods for classification and regression (SVM, KFD…)
3. Introduce students to basics of unsupervised learning and to clustering
4. Introduce students to basic in itemset mining
5. Apply data mining techniques in real-world applications</td></tr>
<tr><td>Intended learning outcomes</td><td>Upon successful completion of this course, students will be able to:
<table>
<tr><th>No</th><th>Intended learning Outcome (ILO)</th><th>Program learning outcome (PLO)*</th></tr>
<tr><td>1</td><td>Demonstrate a sound understanding of the main areas of AIR.</td><td>1</td></tr>
</table>
</td></tr>
</table>

	<table><tr><td>2</td><td>Solve an AIR problem by developing an appropriate optimization approach.</td><td>2,3</td></tr><tr><td>3</td><td>Use Matlab, R or Python libraries to develop programs for solving AIR problems.</td><td>2,3,4</td></tr><tr><td>4</td><td>Apply machine learning techniques in selected applications</td><td>2,3,4,5,6</td></tr></table> (*) The PLOs are listed in the appendix
Teaching and learning methods	Development of ILOs is promoted through the following teaching and learning methods: • Lectures will be delivered through Microsoft Teams/ZOOM and will be recorded for later access. Lectures could be delivered in class if the situation allows it. • The AI Lab is open for the students to practice the practical aspects and solve the programming homework assignments. • The student attends the class presentations and participates in the discussions. • The student joins the related online team/group and participates in its discussions. • The student studies the reference material, including books and videos. • The student solves the programming assignments • The student carries out a term project for solving a problem using Machine Learning techniques. • The student develops a professional report for the term report. • The student presents the term project in class.
Learning material	Textbook, class handouts, some instructor keynotes, selected videos, and access to a personal computer and the internet.
Resources and references	Recommended book(s), material and media: 1) Lecture notes prepared by the Instructor 2) Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly Media, 2nd Edition, 2018. 3) Richard O. Duda, Peter E. Hart and David G. Stork, Pattern Classification, 2nd ed. Wiley, New York, 2001. 4) Mohammed J. Zaki and Wagner Meira, Jr, Data Mining and Machine Learning: Fundamental Concepts and Algorithms, Second Edition Cambridge University Press, March 2020. (ISBN: 978-1108473989) 5) https://dataminingbook.info/ : You can find here resources like slides, videos and other materials for the new edition of the DMA book.
Topic outline and schedule	<table><tr><th>Lecture</th><th>Topic</th><th>Hours</th><th>ILO</th><th>Resources</th></tr><tr><td>1</td><td>Introduction to Data Mining and Machine Learning</td><td>1</td><td>1</td><td>1, 4</td></tr></table>

	2	Data Analysis Foundations: types of data and data preprocessing and preparation + mathematical background	3	1,2,3	1,4
	3	Decision Theory and probabilistic classification: Focuses on Gaussian Case	3	2,3,4	1,3,
	4	Kernel based methods for classification and regression	5	2,3,4	1,2,4
	5	Introduction to neural network for regression and classification	6	2,3,4	1,4,5
	6	Introduction to clustering	3	2,3,4	1,4,5
	7	Frequent Pattern Mining and Association Rules	3	2,3,4	1,4,5

Evaluation tools

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment tools:

Assessment tool	Mark	Topic(s)	Time
Term project report, programs and presentation	50%	Programming and use of optimization toolboxes for engineering problem solving	W12
Final Exam	50%	Decision, classification and data mining	W12
Total	**100%**		

Student requirements

The student should have a computer and internet connection.

Course policies

A- Attendance policies:

- Attendance is required. Class attendance will be taken every class and the university polices will be enforced in this regard.

B- Absences from exams and submitting assignments on time:

- A makeup exam can be arranged for students with acceptable absence causes.
- Assignments submitted late, but before announcing or discussing the solution can be accepted with 25% penalty.
- The project report must be handed in in time.

C- Health and safety procedures:

- All health and safety procedures of the university and the school should be followed.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

- Open-book exams

	• All submitted work must be of the submitting student. • Other text or code must be properly quoted with clear source specification. • Cheating will not be tolerated. E- Available university services that support achievement in the course: • Microsoft Teams team • Control Lab for practicing the practical aspects and solving the programming assignments.
Additional information	None

Appendix

Learning Outcomes for the MSc in Artificial Intelligence and Robotics

Students who successfully complete the MSc in Artificial Intelligence and Robotics (AIR) will be able to:

1. Demonstrate a sound understanding of the main areas of AIR including artificial neural networks, machine learning, data science, industrial and service robots, and intelligent and autonomous robots.

2. Apply a critical understanding of essential concepts, principles and practices of AIR, and critically evaluate tools, techniques and results using structured arguments based on subject knowledge.

3. Apply the methods and techniques of the AIR fields in the design, analysis and deployment of AIR solutions and solving practical problems.

4. Demonstrate the ability to produce a substantial piece of research work from problem inception to implementation, documentation and presentation.

5. Demonstrate life-long learning, independent self-learning and continuous professional development skills in the AIR fields.

6. Demonstrate a sound understanding of the ethical, safety and social impact issues of AIR solutions and products.