# DeCAIR Course Syllabus Form

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| **Organization Name(s)** | Lebanese University | | |
| **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**

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<table>
<tr><td>Course title</td><td>Advances in Statistical Learning</td></tr>
<tr><td>Course number</td><td>RSI05</td></tr>
<tr><td>Credit hours (lecture and lab)</td><td></td></tr>
<tr><td>ECTS (weekly contact and self-study load)</td><td>3 (18 contact hours)</td></tr>
<tr><td>Prerequisites/co-requisites</td><td>RSI 02 (Introduction to Data mining and Machine learning)</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, 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>The objective of this course, which follows RSI02, is to present advanced methods of machine learning, in order to build efficient pattern recognition systems. After a few reminders of the principles of machine learning (supervised, unsupervised, semi-supervised), we will study some advanced pattern recognition techniques. The studied methods will be applied to classic datasets, so as to illustrate their properties and compare them in concrete situations.</td></tr>
<tr><td>Objectives</td><td>1. Introduce students to advanced methods of machine learning.<br>2. Introduce students to advanced pattern recognition techniques<br>3. Apply the studied methods to real-world datasets</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>
<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</td></tr>
<tr><td>Teaching and learning methods</td><td>Development of ILOs is promoted through the following teaching and learning methods:</td></tr>
</table>

<table>
<tr><td></td><td>
<ul>
<li>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.</li>
<li>The AI Lab is open for the students to practice the practical aspects and solve the programming homework assignments.</li>
<li>The student attends the class presentations and participates in the discussions.</li>
<li>The student joins the related online team/group and participates in its discussions.</li>
<li>The student studies the reference material, including books and videos.</li>
<li>The student solves the programming assignments</li>
<li>The student carries out a term project for solving a problem using optimization techniques.</li>
<li>The student develops a professional report for the term report.</li>
<li>The student presents the term project in class.</li>
</ul>
</td></tr>
<tr><td>Learning material</td><td>Textbook, class handouts, some instructor keynotes, selected YouTube videos, and access to a personal computer and the internet.</td></tr>
<tr><td>Resources and references</td><td>Recommended book(s), material and media:<br>
1) Lecture notes prepared by the Instructor<br>
2) Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython, O'Reilly Media, 2nd Edition, 2018.<br>
3) Richard O. Duda, Peter E. Hart and David G. Stork, Pattern Classification, 2nd ed. Wiley, New York, 2001.<br>
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)<br>
5) https://dataminingbook.info/ : You can find here resources like slides, videos and other materials for the new edition of the DMA book.</td></tr>
<tr><td>Topic outline and schedule</td><td>
<table>
<tr><th>Lecture</th><th>Topic</th><th>Hours</th><th>ILO</th><th>Resources</th></tr>
<tr><td>1</td><td>Introduction and reminders: supervised, unsupervised, semi-supervised learning</td><td>2</td><td>1</td><td>1, 4,5</td></tr>
<tr><td>2</td><td>Discriminant analysis (quadratic, linear, and derived models)</td><td>3</td><td>2,3</td><td>1, 3,4,5</td></tr>
<tr><td>3</td><td>Logistic regression</td><td>3</td><td>2,3</td><td>1, 3,4,5</td></tr>
<tr><td>4</td><td>Decision trees and ensemble methods (bagging and random forests, boosting)</td><td>4</td><td>2,3</td><td>1,4,5</td></tr>
<tr><td>5</td><td>EM algorithm, application to unsupervised classification and mixture models and to semi-supervised learning</td><td>6</td><td>2,3</td><td>1,4,5</td></tr>
<tr><td>6</td><td>Term Project Presentations</td><td>3</td><td>1,2 .3</td><td>1,2,4,5</td></tr>
</table>
</td></tr>
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<tr><td></td><td></td></tr>
<tr><td>Evaluation tools</td><td>Opportunities to demonstrate achievement of the ILOs are provided through the following assessment tools:
<table>
<tr><th>Assessment tool</th><th>Mark</th><th>Topic(s)</th><th>Time</th></tr>
<tr><td>Term project report, programs and presentation</td><td>50%</td><td>Programming and use of optimization and ML toolboxes for engineering problem solving</td><td>W12</td></tr>
<tr><td>Final Exam</td><td>50%</td><td>Decision, classification and data mining</td><td>W12</td></tr>
<tr><td>Total</td><td>100%</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Student requirements</td><td>The student should have a computer and internet connection.</td></tr>
<tr><td>Course policies</td><td>A- Attendance policies:<ul><li>Attendance is required. Class attendance will be taken every class and the university polices will be enforced in this regard.</li></ul>B- Absences from exams and submitting assignments on time:<ul><li>A makeup exam can be arranged for students with acceptable absence causes.</li><li>Assignments submitted late, but before announcing or discussing the solution can be accepted with 25% penalty.</li><li>The project report must be handed in in time.</li></ul>C- Health and safety procedures:<ul><li>All health and safety procedures of the university and the school should be followed.</li></ul>D- Honesty policy regarding cheating, plagiarism, misbehavior:<ul><li>Open-book exams</li><li>All submitted work must be of the submitting student.</li><li>Other text or code must be properly quoted with clear source specification.</li><li>Cheating will not be tolerated.</li></ul>E- Available university services that support achievement in the course:<ul><li>Microsoft Teams team</li><li>Control Lab for practicing the practical aspects and solving the programming assignments.</li></ul></td></tr>
<tr><td>Additional information</td><td>None</td></tr>
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# 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.