DeCAIR Course Syllabus Form

Author(s)	Gheith Abandah		
Author Organization Name(s)	The University of Jordan		
Work Package Number & Title	Work Package 2: Development of new MSc and BSc programs in AIR		
Activity Number & Title	Activity 2.2: Designing and developing syllabi and content for the agreed upon courses in the new programs		
Work Package Leader	Francesco Masulli, University of Genoa		
Due Date of Delivery	1/2/2022	**Project Month**	M14
Submission Date	23/11/2021	**Project Month**	M10

Revision History

Version	Date	Author	Description	Action *	Page(s)
1	9/12/2021	Gheith Abandah	Original (base) document	C	1-6
2				U	
3					
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.

Email: DeCAIR@ju.edu.jo

Project Website: http://DeCAIR.ju.edu.jo/

<table>
<tr><td>Course title</td><td>Advanced Topics in Machine Learning</td></tr>
<tr><td>Course number</td><td>0907522</td></tr>
<tr><td>Credit hours (lecture and lab)</td><td>3 (3 + 0)</td></tr>
<tr><td>ECTS (weekly contact and self-study load)</td><td>6 (3 + 3)</td></tr>
<tr><td>Prerequisites/co-requisites by course number and name</td><td>AI and Machine learning (0917451)</td></tr>
<tr><td>Prerequisites by topic (other than the formal prerequisites above)</td><td>Students are assumed to have good background in machine learning and neural networks. Additionally, the students should have good Python programming skills.</td></tr>
<tr><td>Level and type (compulsory, elective)</td><td>BSc elective course</td></tr>
<tr><td>Year of study and semester</td><td>Fifth year, first or second semester</td></tr>
<tr><td>Catalogue description</td><td>Theory and implementation of state-of-the-art machine learning (ML) algorithms for real-world applications. Topics include supervised learning (applications in natural languages processing (NLP), sequence transcription, sentiment analysis, transformers, BERT), unsupervised learning (clustering, density estimation, dimensionality reduction, anomaly detection, and association rule learning), and reinforcement learning (RL). This course has practical assignments and term project.</td></tr>
<tr><td>Objectives</td><td>1. Introduce students to advanced techniques used in ML including techniques in supervised, unsupervised, and reinforcement learning techniques.
2. Enable the students to gain practical skills in solving advanced problems using ML techniques.</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 advanced techniques and algorithms in ML.</td><td>1</td></tr>
<tr><td>2</td><td>Solve an advanced AI problem by developing an appropriate ML system.</td><td>1</td></tr>
<tr><td>3</td><td>Communicate the development of a ML system through a detailed technical report.</td><td>3</td></tr>
<tr><td>4</td><td>Use Python and specialized libraries to develop programs for solving ML problems.</td><td>2</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>

	• 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 in machine learning. • The student carries out a term project for solving an advanced problem using ML techniques. • The student develops a professional report for the term report.
Learning material type	Textbook, class handouts, some instructor keynotes, selected YouTube videos, and access to a personal computer and the internet.
Resources and references	A- Required book(s), assigned reading and audio-visuals: 1. H. Lane, C. Howard, and H. Hapke, Natural Language Processing in Action Understanding, analyzing, and generating text with Python, Manning, 2019. 2. Aaron Jones, Christopher Kruger, and Benjamin Johnston, The Unsupervised learning Workshop, Packt Publishing, 2020. 3. Nimish Sanghi, Deep Reinforcement Learning with Python: With PyTorch, TensorFlow and OpenAI Gym, Apress, 2021. 4. Course web page at: … B- Recommended book(s), material and media: 5. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow: Concepts: Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly Media, Oct 2019. 6. Richard S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction, Second Edition, MIT Press, 2019 7. François Chollet, Deep Learning with Python, Manning Pub. 2018.
Topic outline and schedule	

Week	Topic	ILO	Resources
1	Introduction to NLP	1, 2, 4	1, 5
2	Word tokenization and embedding	1, 2, 4	1
3	Sentiment analysis and text categorization	1, 2, 4	1
4	Sequence transcription	1, 2, 4	1
5	Attention, transformers, and BERT	1, 2, 4	1, 4
7	Clustering techniques	1, 2, 4	2
8	Density estimation	1, 2, 4	2
9	Dimensionality reduction	1, 2, 4	2
10	Anomaly detection	1, 2, 4	2
11	Association rule learning	1, 2, 4	2

	12 | Introduction to RL | 1, 2, 4 | 3, 6 13 | Classical RL techniques | 1, 2, 4 | 3, 6 14 | Policy gradient algorithms | 1, 2, 4 | 3, 6 15 | Q learning | 1, 2, 4 | 3, 6
Evaluation tools	Opportunities to demonstrate achievement of the ILOs are provided through the following assessment tools: **Assessment tool** | **Mark** | **Topic(s)** | **Time** Homework assignments | 10% | Programming aspects | W2-W14 Midterm exam | 30% | Introduction through density estimation | W8 Term project report | 10% | Practical and communication aspects | W15 Final exam | 50% | All material | W16 **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 not 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 and Moodle course page • AI Lab for practicing the practical aspects and solving the programming assignments. • Program announcements Facebook group

Additional information	None

Appendix

Learning Outcomes for the BSc in Computer Engineering

Students who successfully complete the BSc in Computer Engineering will be able to demonstrate:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.