DeCAIR Course Syllabus Form

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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		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	30/10/2021	Ahmad Aljaafreh	Original (base) document	C	1-6
2	16/1/2022	Ahmad Aljaafreh	Revised based on a peer review	U	1-6
3	2/2/2022	Ahmad Aljaafreh	Revised based on an expert review	U	1-6

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

Disclaimer

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Course title	Introduction to Artificial Intelligence and Machine Learning
Course number	0112467
Credit hours (lecture and lab)	3 (3 + 0)
ECTS (weekly contact and self-study load)	6 (3 + 3)
Prerequisites/co-requisites by course number and name	Data structure and algorithms (0107352)
Prerequisites by topic (other than the formal prerequisites above)	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.
Level and type (compulsory, elective)	Bachelor' compulsory course
Year of study and semester	second year, first semester
Catalogue description	In this course, you will learn the fundamental concepts of Artificial Intelligence (AI) and apply them to the design and implementation of intelligent agents that solve real-world AI problems, including problems in search, games, machine learning, logic, and constraint satisfaction. This course provides a broad understanding of the basic techniques for building intelligent computer systems. Topics include the history of AI, intelligent agents, state-space problem representations, uninformed and heuristic search, game playing and adversarial search, logical agents, constraint satisfaction problems, along with techniques in machine learning and other applications of AI, such as natural language processing (NLP).
Objectives	1- Introduce students to machine learning (ML) and artificial intelligence (AI) 2- Introduce students to the techniques used in ML including data preparation, training models, regression, classification, neural networks, and deep learning. 3- Introduce students to the practical techniques used in developing ML systems including sample collection, training, and evaluation. 4- Introduce students to the programming techniques and libraries used in ML (Python, Scikit-Learn, Keras, and TensorFlow). 5- Enable the students to gain practical skills in solving wide range of problems using ML techniques. 6- Students will be given a practical understanding of the methods being taught, in particular through making their own implementations of several of the methods.
Intended learning outcomes	Upon successful completion of this course, students will be able to:

No	Intended learning Outcome (ILO)	Program learning outcome (PLO)*

	1	have insight into the main methods used in machine learning (ML) and artificial intelligence (AI)	1,2,6
	2	have knowledge of the historical development of the field	1,6
	3	be able to design and conduct experiments using the methods, with emphasis on evaluation	1,6
	4	be able to consider the pros and cons when choosing ML / AI methods for different applications	6
	5	be able to implement algorithms for selected methods	2,5
	(*) 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 and will be recorded for later access. • 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 deep learning techniques. • The student develops a professional report for the term report. • The student presents the term project in class.		
Learning material type	Class handouts, some instructor keynotes, selected YouTube videos, and access to a personal computer and the internet and a number of the supporting readings.		
Resources and references	There is no required textbook for this class, and you should be able to learn everything from the lecture notes and homework. However, if you would like to pursue more advanced topics or get another perspective on the same material, here are some books: 1- Russell and Norvig. Artificial Intelligence: A Modern Approach, Fourth Edition, 2021. A comprehensive reference for all the AI topics that we will cover. 2- Koller and Friedman. Probabilistic Graphical Models,2009 Covers factor graphs and Bayesian networks. 3- Sutton and Barto. Reinforcement Learning: An Introduction, 2015. Covers Markov decision processes and reinforcement learning. Available free online. 4- Hastie, Tibshirani, and Friedman. The elements of statistical learning, 2009. Covers machine learning. Available free online. 5- Prateek Joshi, Artificial Intelligence with Python, Packt Publishing, 2017.		

<table>
<tr><td></td><td>6- Tsang. Foundations of constraint satisfaction, 1993. Covers constraint satisfaction problems. Available free online.</td></tr>
<tr><td>Topic outline and schedule</td><td>
<table>
<tr><th>Week</th><th>Topic</th><th>ILO</th><th>Resources</th></tr>
<tr><td>1</td><td>Introduction to AI, course logistics and roadmap, Intelligent agents.</td><td>1</td><td>1,2</td></tr>
<tr><td>2</td><td>uninformed search, Heuristic search, greedy search</td><td>2</td><td>1,,2,5</td></tr>
<tr><td>3,4</td><td>A* algorithm, stochastic search, Adversarial search, game playing</td><td>1, 2, 3</td><td>1,2,5</td></tr>
<tr><td>5,6</td><td>Machine Learning 1: basic concepts, linear models, K nearest neighbors, overfitting</td><td></td><td>1,3</td></tr>
<tr><td>7,8</td><td>Machine Learning 2: perceptron, neural networks, naive Bayes</td><td></td><td>1</td></tr>
<tr><td>9,10</td><td>Machine Learning 3: Decision trees, ensemble, logistic regression, unsupervised learning, and constraint satisfaction problems.</td><td>1, 2, 4</td><td>1</td></tr>
<tr><td>11</td><td>Logical agents, propositional logic and first order logic</td><td>1, 2</td><td>1,4</td></tr>
<tr><td>12,13</td><td>Markov decision processes, reinforcement learning,</td><td>1</td><td>1,4</td></tr>
<tr><td>14</td><td>AI applications</td><td>1, 2</td><td>1</td></tr>
<tr><td>15</td><td>Term project presentations</td><td>1, 2</td><td>1</td></tr>
</table>
</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>Homework assignments</td><td>10%</td><td>Programming aspects</td><td>W2-W14</td></tr>
<tr><td>Midterm exam</td><td>30%</td><td>Introduction through classical techniques</td><td>W8</td></tr>
<tr><td>Term project report and presentation</td><td>20%</td><td>Practical and presentation aspects</td><td>W15</td></tr>
<tr><td>Final exam</td><td>40%</td><td>All material</td><td>W16</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:
• 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.</td></tr>
</table>

	• 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 B.S. IN INTELLIGENT SYSTEMS ENGINEERING

Students who successfully complete the B.S. IN INTELLIGENT SYSTEMS ENGINEERING will have:

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.