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	24/11/2021	Gheith Abandah	Original (base) document	C	1-6
2	22/2/2024	Gheith Abandah	Modifications for Spring 2024 term	U	1-6
3					
4					

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

Disclaimer

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Course title	Natural Languages Processing Spring 2024
Course number	0907753
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	Applied Machine Learning (0907726)
Prerequisites by topic (other than the formal prerequisites above)	Students are assumed to have good background in machine learning and Python programming skills.
Level and type (compulsory, elective)	Masters' elective course
Year of study and semester	First year, second semester or Second year, first semester
Catalogue description	Computational properties of natural languages. Coreference, question answering, and machine translation. Processing linguistic information. Syntactic and semantic processing. Modern quantitative techniques in natural languages processing (NLP). Neural network models for language understanding tasks. Term project.
Objectives	1. Introduce students to the NLP applications and techniques. 2. Introduce students to the practical techniques used in developing NLP solutions. 3. Introduce students to the programming techniques and libraries used in NLP (Python, Scikit-Learn, NLTK, Gensim, and Keras). 4. Enable the students to gain practical skills in solving wide range of NLP problems using modern techniques.

<table>
<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 techniques and algorithms in NLP.</td><td>1</td></tr>
<tr><td>2</td><td>Solve an NLP problem by developing an appropriate NLP system.</td><td>3</td></tr>
<tr><td>3</td><td>Communicate the development of an NLP system through a detailed technical report and a short presentation.</td><td>4</td></tr>
<tr><td>4</td><td>Use Python and its specialized libraries to develop programs for solving NLP problems.</td><td>3</td></tr>
<tr><td>5</td><td></td><td></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:
• Project-based and assignment-based learning
• 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 class MS Teams team (link) and participates in its discussions.
• The student studies the reference material, including books and videos.
• The student solves the programming assignments in NLP.
• The student carries out a term project for solving an NLP problem using ML techniques.
• The student develops a professional report for the term report.
• The student presents the term project in class.</td></tr>
<tr><td>Learning material type</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>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. Course web page at: https://www.abandah.com/gheith/?page_id=3182
B- Recommended book(s), material, and media:
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow: Concepts: Tools, and Techniques to Build Intelligent Systems, 3rd Edition, O'Reilly Media, Oct 2022.
4. François Chollet, Deep Learning with Python, 2nd Edition, Manning Pub. Oct 2021.</td></tr>
</table>

5. Tunstall, Lewis, Leandro Von Werra, and Thomas Wolf. Natural language processing with transformers. " O'Reilly Media, Inc.", 2022.
6. Cuantum Technologies, Introduction to Natural Language Processing with Transformers, 2023.
7. Jurafsky, Daniel, and James H. Martin. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition." 3rd Ed. Draft, 2024.

Topic outline and schedule

Week	Topic	ILO	Resources
1	Introduction to NLP	1	1
2	Word tokenization	1, 2, 4	1
3	Math with words: TF-IDF vectors	1, 2, 4	1
4	Semantic analysis	1, 2, 4	1
6	Reasoning with word vectors	1, 2, 4	1
7	Convolutional neural networks in NLP	1, 2, 4	1, 3, 4
8	Recurrent neural networks in NLP	1, 2, 4	1, 3, 4
9	Long short-term memory networks	1, 2, 4	1, 3, 4
10	Sequence-to-sequence models and attention	1, 2, 4	1
11	Transformers and BERT	1, 2, 4	5, 6
12	Named entity extraction and question answering	1, 2, 4	1
13	Dialog engines	1, 2, 4	1
14	Optimization, parallelization, and batch processing	1, 2, 4	1
15	Term Project Presentations	3, 4	3

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 RNNs	W8
Term project report and presentation	20%	Practical and presentation aspects	W15
Final exam	40%	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: Link • AI Lab for practicing the practical aspects and solving programming assignments. • Program announcements Facebook group Link
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. Analyze and discuss the basic concepts, principles, techniques, and theories in AIR including artificial neural networks, machine learning, data science, industrial and service robots, and intelligent and autonomous robots.

2. Use critical thinking on concepts, principles, and practices related to AIR, and rigorously evaluate tools, techniques, and outcomes using structured arguments based on subject knowledge.

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

4. Show the ability to produce distinguished research work from problem inception to implementation, and write quantitative and qualitative reports, and deliver them orally and in writing.

5. Demonstrate life-long learning, independent self-learning, and continuous professional development skills, and apply new AIR knowledge.

6. Take responsibility, work effectively within a team, abide by professional ethics and societal values in performing tasks and work, and apply work ethics and professional honor codes.

7. Use practical research methodologies to analyze and investigate issues related to AIR.