DeCAIR Course Syllabus Form

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WP 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		
WP Leader	Francesco Masulli, University of Genoa		
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Revision History

Version	Date	Author	Description	Action *	Page(s)
1	5/11/2021	Eyad Almaita	Original (base) document	C	1-6
2	6/12/2021	TTU Team	Revision	U	2-4
3					
4					

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

Disclaimer

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<table>
<tr><td>Course title</td><td>Artificial Intelligence for Robotics</td></tr>
<tr><td>Course number</td><td>0112561</td></tr>
<tr><td>Credit hours</td><td>3</td></tr>
<tr><td>ECTS (weekly contact and self-study load)</td><td>6(3+3)</td></tr>
<tr><td>Prerequisites/co-requisites</td><td>Robotics systems (0109563), Artificial Neural Network and Deep Learning (0112564)</td></tr>
<tr><td>Prerequisites by topic</td><td>Students are assumed to have good background in robotics systems, machine learning. Additionally, the students should have good programming skills.</td></tr>
<tr><td>Level and type (compulsory, elective)</td><td>bachelor’s compulsory course</td></tr>
<tr><td>Year of study and semester</td><td>Fifth year, first semester</td></tr>
<tr><td>Description</td><td>This course will focus of using the techniques of artificial intelligence in the robotics field. This course will cover probabilistic inference, planning and search algorithms, localization, tracking, and intelligent control. Also, this course will teach the key concepts used by autonomous mobile platforms and provide hands-on experience with state-of-the-art software and systems.</td></tr>
<tr><td>Objectives</td><td>To enable the students to apply techniques and tools within computer and artificial intelligence in order to specify, design, use and maintain advanced robotics systems.</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>Write software that interacts with robotic hardware.</td><td>2</td></tr>
<tr><td>2</td><td>Implement and apply algorithms that address several key problems in robotics, such as Sensor fusion, Localization and mapping Visual object detection</td><td>1,5</td></tr>
<tr><td>3</td><td>Implement search algorithms (including A*) to plan the shortest path from one point to another subject to costs on different types of movement.</td><td>1,5</td></tr>
<tr><td>4</td><td>Design an intelligent controller to smoothly correct an autonomous robot’s course.</td><td>1,3</td></tr>
<tr><td>5</td><td>Implement a SLAM algorithm for a robot moving in at least two dimensions.</td><td>7</td></tr>
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(*) The PLOs are listed in the appendix

Many implementations (good), take into account this “practical” time during the weeks of the course</td></tr>
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<table>
<tr><td>Teaching and learning methods</td><td>Development of ILOs is promoted through the following teaching and learning methods:
Lectures will be delivered in class
The AI and Robot 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 a 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</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:
Computational Principles of Mobile Robotics, 2nd Edition. Gregory Dudek and Michael Jenkin, Cambridge University Press, 2010
Programming Robots with ROS: A Practical Introduction to the Robot Operating System (1st Edition) by Morgan Quigley, Brian Gerkey, William D. Smart. O'Reilly.
Course web page at: …
B- Recommended book(s), material and media:<ol start="4">
Corke, Peter: Robotics, Vision and Control - Fundamental Algorithms in MATLAB®. 73 : Springer, 2011.
Jazar, Reza N. Theory of applied robotics: kinematics, dynamics, and control. Springer Science & Business Media, 2010.</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 for Robotics</td><td>1</td><td>2,3</td></tr>
<tr><td>2-3</td><td>Sensor fusion, state estimation, and localization</td><td>2, 3</td><td>4,5</td></tr>
<tr><td>4-5</td><td>Robot Motion Control</td><td>4</td><td>1,5</td></tr>
<tr><td>6-7</td><td>SLAM (Simultaneous Localization and Mapping)</td><td>5</td><td>1,5</td></tr>
<tr><td>8</td><td>ROS</td><td>5</td><td>2</td></tr>
<tr><td>9</td><td>Navigation</td><td>5</td><td>2</td></tr>
<tr><td>10-11</td><td>Integrating perception, learning & control</td><td>2</td><td>2, 4</td></tr>
<tr><td>12</td><td>Novel object recognition & manipulation</td><td>2,3</td><td>2, 4</td></tr>
<tr><td>13-14</td><td>Scalable and reinforcement learning</td><td>2</td><td>2</td></tr>
<tr><td>15</td><td>Term Project Presentations</td><td>2,3, 4</td><td>3</td></tr>
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</td></tr>
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<table>
<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>till Robot Motion Control using PID</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 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</td></tr>
<tr><td>Additional information</td><td>None</td></tr>
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PLOs for the BSc in Intelligent Systems Engineering

Students who complete the BSc in Intelligent Systems Engineering (ISE) will be able to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. 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. Communicate effectively with a range of audiences.

4. 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. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

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

7. Acquire and apply new knowledge as needed, using appropriate learning strategies.