EDLRIS
European Driving License for Robots and Intelligent Systems

Course Structure Overview

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Artificial Intelligence BASIC

Core competences of a graduate:

**ab1:** Is able to describe AI, to recognize AI systems and to distinguish AI systems from other concepts and systems.

**ab2:** Knows the areas of application of AI and their use cases and is aware of the technical, social, ethical and legal implications.

**ab3:** Is able to formalize a problem and to apply algorithms and data structures to solve this problem.

**ab4:** Is able to design and practically implement a very simple AI system for a given application.

Additional competences of a graduated trainer:

**t1:** Is able to select and use an adequate teaching method that meets the student’s need for instruction.

**t2:** Understands and adopts the learner-centered approach of the program.

**t3:** Is familiar with the assessment criteria of the EDLRIS program.

**t4:** Is familiar with the online training approach applied in the EDLRIS program.
Artificial Intelligence BASIC course structure:

<table>
<thead>
<tr>
<th>Face-to-Face (F2F)</th>
<th>Online</th>
<th>F2F</th>
<th>Online</th>
<th>F2F</th>
<th>Day 5</th>
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</thead>
<tbody>
<tr>
<td><strong>Day 1</strong></td>
<td>Python online learning course</td>
<td>Questions and answers to online session.</td>
<td>Machine Learning ML</td>
<td>Search algorithms intro:</td>
<td>Project day: implement a practical project (360 min; ab4)</td>
</tr>
<tr>
<td>Getting to know each other.</td>
<td>User Input; Variables; Data Types and Math; If/Else; Lists; Loops;</td>
<td>(20 min; ab4)</td>
<td>(270 min; ab2, ab3)</td>
<td>Graph and Tree Data Structures; Stack and Queue; Breath-Fist Search;</td>
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<tr>
<td>Introduction to EDLRIS.</td>
<td>Libraries; RegEx;</td>
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<td>Depth-First Search; A* Search;</td>
<td>CV and ML ethics.</td>
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<tr>
<td>(40 min; t2,t3,t4)</td>
<td>(1-2 weeks; ab4)</td>
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<td>(1-2 weeks; ab3)</td>
<td>(30 min; ab2)</td>
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<tr>
<td><strong>AI Definitions and Applications.</strong></td>
<td>Programming and Natural Language Processing NLP</td>
<td>Bot-challenge.</td>
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<tr>
<td>(70 min; ab1, ab2)</td>
<td>(225 min; ab3, ab4)</td>
<td>(30 min; ab4)</td>
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<tr>
<td><strong>Natural Language Processing.</strong></td>
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<td>Search ethics.</td>
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<tr>
<td>(125 min; ab1, ab2, ab3)</td>
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<td>(30 min; ab2)</td>
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<td><strong>Using Logic to Create Meaning</strong></td>
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<td>(75 min; ab3)</td>
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<td><strong>Day 2</strong></td>
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<td><strong>Day 4</strong></td>
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<td><strong>Online</strong></td>
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<td><strong>Project day:</strong></td>
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<td><strong>Introduction to Programming:</strong></td>
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<tr>
<td>Preparation for Online Sessions</td>
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<td>(20 min; ab4)</td>
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<td><strong>Reflection:</strong></td>
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<td>Teaching methods (only trainers)</td>
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<td>(30 min; t1,t2)</td>
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<td><strong>Reflection:</strong></td>
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<td>Machine Learning ML</td>
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<td>(270 min; ab2, ab3)</td>
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<td><strong>Project suggestions and preparation.</strong></td>
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<td>(30 min; ab4)</td>
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<td><strong>Computer Vision CV.</strong></td>
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<td>(45 min; ab1, ab2, ab3)</td>
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<td>(30 min; t1,t2)</td>
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Artificial Intelligence ADVANCED

Core competences of a graduate:

- **aa1**: Is familiar with different AI areas and frameworks and is aware of ethical, social and legal implications of AI systems.
- **aa2**: Masters the required mathematical basics and is able to understand and describe basic AI concepts.
- **aa3**: Is able to describe problems, which require an AI-related solution, in a formal way, and furthermore, is able to efficiently solve those problems by applying adequate algorithms.
- **aa4**: Knows the fundamental properties of problems, representations and algorithms.
- **aa5**: Is able to analyze, configure, maintain and integrate an existing AI tool and is able to systematically design and practically implement an AI system for a given application.

Additional competences of a graduated trainer:

- **t1**: Is able to select and use an adequate teaching method that meets the student’s need for instruction.
- **t2**: Understands and adopts the learner-centered approach of the program.
- **t3**: Is familiar with the assessment criteria of the EDLRIS program.
- **t4**: Is familiar with the online training approach applied in the EDLRIS program.
Artificial Intelligence ADVANCED course structure:

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<tr>
<th>Day 1</th>
<th>Online</th>
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<th>Day 4</th>
<th>F2F</th>
<th>Day 5</th>
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<tbody>
<tr>
<td>Getting to know each other. Introduction to EDLRIS. (40 min; t2,t3,t4)</td>
<td>Recap of required knowledge coding, data structures (graph, tree), time - space complexity, common algorithms (DFS, BFS)</td>
<td>Fundamental mathematical concepts (90 min; aa2, aa4)</td>
<td>Basic AI concepts – concrete examples: Modeling of a problem; Problem analysis; Problem solving (270 min; aa2,aa3, aa4)</td>
<td>Most common frameworks for different AI areas (introduction, online examples) (1-2 weeks; ab1)</td>
<td>Properties of representations and algorithms. (90 min; aa4)</td>
<td>Project day: implement a practical project (270 min; aa5)</td>
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<tr>
<td>AI Definitions and history of AI (45 min; aa1)</td>
<td>Fundamental mathematical concepts</td>
<td>Basic AI concepts (theory + examples): Search Declarative Data driven (270 min; aa2,aa4)</td>
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<tr>
<td>AI areas: overview, challenges, questions behind, applications: NLP, CV, ML, KR&amp;R, planning, common sense (275 min; aa1)</td>
<td>AI areas: challenges, questions behind, applications (1-2 weeks; aa1, aa2, aa4)</td>
<td>Technical, social, economic, ethical and legal implications of the application of AI (90 min; a1)</td>
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<td>Project draft and preparation. (90 min; aa5)</td>
<td>Reflect on the teaching methods used in this course and feedback (only for trainers) (90 min; t1,t2)</td>
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Robotics BASIC

Core competences of a graduate:

- **rb1:** Is familiar with the history, the background, the terminology and the fields of application of robotics and its use-cases and knows about the social, ethical and legal implications.
- **rb2:** Understands the big picture of robot system i.e. the context and the ecosystem where the robot is integrated.
- **rb3:** Understands the potential of robotics and is creative in imagining new scenarios of robotics, like human user interaction.
- **rb4:** Knows and understands the fundamental robotics concepts.
- **rb5:** Knows the components required to implement the fundamental robotics concepts.
- **rb6:** Is able to integrate the components in a robotics system for a simple task.

Additional competences of a graduated trainer:

- **t1:** Is able to select and use an adequate teaching method that meets the student’s need for instruction.
- **t2:** Understands and adopts the learner-centered approach of the program.
- **t3:** Is familiar with the assessment criteria of the EDLRIS program.
- **t4:** Is familiar with the online training approach applied in the EDLRIS program.
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<tbody>
<tr>
<td><strong>Day 1</strong></td>
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</tbody>
</table>
| Getting to know each other. Introduction to EDLRIS.  
* (45 min; t2,t3,t4) | Each participant investigates real robotics systems and identifies its robotics components. Then she/he prepares at least on example which will then be presented and discussed in Day 2.  
* (1-2 weeks; rb1, rb2, rb3) | Presentation of the online investigated examples by each participant, discussion and reflection.  
* (45 min; rb2) | Solve Project 1 (see below for project description) using graphical programming.  
* (90 min; rb6) | Learn the basics of Python programming. Create a model of a robot using flowchart design (sense-plan-act).  
* (1-2 weeks; rb4, rb6) | Participant present their model (flowchart) to the group, discussion, reflection.  
* (90 min; rb4) |
| History, terminology, applications and use cases of robotics.  
* (45 min; rb1) | Open innovation: new applications, markets, innovative ideas, future robotics applications, blended society – HRI  
* (180 min; rb3) | Introduction to text-based programming (Python for EV3).  
* (90 min; rb6) | Solve Project 2a) Solve Project 2b) using Python or EV3  
* (270 min; rb6) | Solve a free project (optional for gifted participants)  
* (90 min; rb6) |
| Ethics, social and legal implications.  
* (45 min; rb1) | Construct a simple mobile robot (without sensors).  
* (45 min; rb2, rb4, rb5) | Solve Project 1 using text-based programming Python for EV3.  
* (90 min; rb6) | | |
| What is in the box – familiarizing with robotics components  
* (225 min; rb1, rb2, rb5) | Introduction to graphical programming (EV3): design simple programs.  
* (90 min; rb1, rb2, rb5) | How to do modelling (introduction to flow charts and structural models).  
* (90 min; rb4) | | |
| | | | | Reflect on the teaching methods used in this course and feedback (only for trainers)  
* (90 min; t1,t2) | | | |
Robotics Basic Project 1:
Standard Lego robot without sensors (no feedback; participants should realize that without any sensing/feedback the distance varies at each run):

- The robot drives with fixed speed and time towards a traffic light;
- The incline of the way is changed (e.g. by using a ramp)

Robotics Basic Project 2:

Project 2a:
Standard Lego robot with color sensor facing down (sensor feedback):
- The robot drives forward and reads the ‘traffic lights’ from colored spots (red, green, yellow) and reacts accordingly.

Project 2b:
Standard Lego robot with color sensor and light sensor facing down (sensor feedback):
- The robot drives along a path (line follower) and reads the ‘traffic lights’ from colored spots (red, green, yellow) and reacts accordingly.

Robotics Basic Project 3:

Project 3a:
Line-Follower Lego robot with color sensor and light sensor facing down + obstacle detection (sensor feedback, states):
- The robot drives along a path (line follower) and detects obstacles in front of it;
- The robot avoid obstacle and find again the line.

Project 3b:
Line-Follower Lego robot with color sensor and light sensor facing down:
- The robot drives along a path (line follower) and detects colored spots at street crossings;
- The robot has to decide to turn right/left/straight according to the color of the spot in order to reach the target destination.
Robotics ADVANCED

Core competences of a graduate:

ra1: Masters the required basics of mathematics, programming and physics.
ra2: Knows about and is able to apply a fundamental systematic engineering approach.
ra3: Is able to design formal models with regard to mechanical, electrical and computational aspects and is capable to model, simulate and design robots.
ra4: Has knowledge of the fundamental mechanical, electronic and algorithmic and computer science concepts and is able to apply appropriate tools and methods required to configure and to implement a robotics system.
ra5: Works with real life equipment (robots).
ra6: Integrates soft skills (ethical and social considerations) in robot design.

Additional competences of a graduated trainer:

t1: Is able to select and use an adequate teaching method that meets the student’s need for instruction.
t2: Understands and adopts the learner-centered approach of the program.
t3: Is familiar with the assessment criteria of the EDLRIS program.
t4: Is familiar with the online training approach applied in the EDLRIS program.
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<tr>
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<tbody>
<tr>
<td>Acquiring required prior knowledge:</td>
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<tr>
<td>Linear algebra</td>
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<tr>
<td>Mechanics, Physics (kinematics 2D, forces, torques)</td>
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<tr>
<td>Programming in Python (ra1)</td>
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### Day 1
- Getting to know each other. Introduction to EDLRIS. *(45 min; t2,t3,t4)*
- Introduction to Robotics systems. *(140 min; ra2)*
- Geometric model (manipulator; forward kinematics) *(175 min; ra3)*

### Online
- Exercises in Python
- Implementation of the geometric model in Python.
- Study of inverse geometrical model.
- Study of the manipulator construction. *(1-2 weeks; ra1, ra2, ra3)*

### Day 2
- Solutions for the inverse geometric model. *(60 min; ra3)*
- Implementation of the inverse geometric model in Python. *(60 min; ra1, ra3)*
- The manipulator simulator. *(60 min; ra3, ra4)*
- Experiments with the manipulator: drawing a curve. *(180 min; ra4, ra5)*

### Day 3
- Mobile Robots: big picture, sensors. *(90 min; ra2, ra3)*
- Mobile Robots: the geometrical model. *(90 min; ra3)*
- Mobile Robots: the kinematical model. *(180 min; ra3)*
- Mobile Robots: the geometrical and kinematical models in Python; open loop (task drive a circle); *(ra1, ra3)*
- Ethical and social considerations in robotics *(ra6)* *(2 weeks)*

### Day 4
- Implementation of the state estimators and PID controllers in Python. *(180 min; ra3)*
- Sensor fusion. *(60 min; ra3)*
- PID introduction. *(60 min; ra3)*
- Implementation of the state estimators and PID controllers in Python. *(180 min; ra3)*

### Day 5
- The state Estimator. *(60 min; ra3)*
- Practical work with the mobile robot (project: “driver assistant system”). *(270 min; ra4,ra5)*
- Reflect on the teaching methods used in this course and feedback (only for trainers) *(90 min; t1,t2)*

*Note: ra1, ra2, ra3, ra4, ra5, ra6 represent different sections or groupings within the course.*