EDLRIS
European Driving License for Robots and Intelligent Systems

Course Structure Overview

Content:

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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.

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Artificial Intelligence BASIC course structure:

<table>
<tr><th>Face-to-Face (F2F)</th><th>Online</th><th colspan="2">F2F</th><th>Online</th><th colspan="2">F2F</th></tr>
<tr><th>Day 1</th><td rowspan="7">
Python online learning course
User Input;
Variables;
Data Types and Math;
If/Else;
Lists;
Loops;
Functions;
Libraries;
RegEx;

(1-2 weeks; ab4)</td><th>Day 2</th><th>Day3</th><td rowspan="7">
Search algorithms intro:

Graph and Tree Data Structures;
Stack and Queue;
Breath-Fist Search;
Depth-First Search;
A* Search;

(1-2 weeks; ab3)</td><th>Day 4</th><th>Day 5</th></tr>
<tr><td>Getting to know each other.
Introduction to EDLRIS.
(40 min; t2,t3,t4)</td><td rowspan="2">Questions and answers to online session.
(20 min; ab4)</td><td rowspan="3">Machine Learning ML
(270 min; ab2, ab3)</td><td>Questions and answers to online session.
(20 min; ab3)</td><td rowspan="7">Project day: implement a practical project
(360 min; ab4)</td></tr>
<tr><td>AI Definitions and Applications.
(70 min; ab1, ab2)</td><td rowspan="2">Programming and Natural Language Processing NLP
(225 min; ab3, ab4)</td><td rowspan="2">Problem solving by search algorithms: practical examples.
(240 min; ab3)</td></tr>
<tr><td>Natural Language Processing.
(125 min; ab1, ab2, ab3)</td></tr>
<tr><td>Using Logic to Create Meaning
(75 min; ab3)</td><td>Bot-challenge.
(30 min; ab4)</td><td>CV and ML ethics.
(30 min; ab2)</td><td>Search ethics.
(30 min; ab2)</td></tr>
<tr><td>Introduction to Programming: Preparation for Online Sessions
(20 min; ab4)</td><td>NLP – ethics.
(30 min; ab2)</td><td>Introduction to search
(30 min; ab1)</td><td>EDRLIS course reflection and feedback.
(30 min; t1,t2)</td></tr>
<tr><td>Reflection: Teaching methods (only trainers)
(30 min; t1,t2)</td><td>Computer Vision CV.
(45 min; ab1, ab2, ab3)</td><td>Reflection: Teaching methods (only trainers)
(30 min; t1,t2)</td><td>Project suggestions and preparation.
(30 min; ab4)</td></tr>
</table>

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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.

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Artificial Intelligence ADVANCED course structure:

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<tr><th>Day 1</th><td rowspan="4"></td><th>Day 2</th><th>Day3</th><td rowspan="4"></td><th>Day 4</th><th>Day 5</th></tr>
<tr><td>Getting to know each other.
Introduction to EDLRIS.
(40 min; t2,t3,t4)</td><td rowspan="3">Fundamental mathematical concepts
(90 min; aa2, aa4)</td><td rowspan="2">Basic AI concepts – concrete examples:
Modeling of a problem;
Problem analysis;
Problem solving
(270 min; aa2,aa3, aa4)</td><td>Properties of representations and algorithms.
(90 min; aa4)</td><td rowspan="2">Project day: implement a practical project
(270 min; aa5)</td></tr>
<tr><td>AI Definitions and history of AI
(45 min; aa1)</td><td rowspan="2">Most common frameworks for different AI areas (questions, F2F exercises)
(180 min; aa1)</td></tr>
<tr><td>AI areas: overview, challenges, questions behind, applications: NLP, CV, ML, KR&R, planning, common sense
(275 min; aa1)</td><td>Basic AI concepts (theory + examples):
Search
Declarative
Data driven
(270 min; aa2,aa4)</td><td rowspan="2">Technical, social, economic, ethical and legal implications of the application of AI
(90 min; a1)</td><td rowspan="2">Most common frameworks for different AI areas (introduction, online examples)

(1-2 weeks; ab1)</td><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></tr>
<tr><td></td><td>Recap of required knowledge coding, data structures (graph, tree), time - space complexity, common algorithms (DFS, BFS)

Fundamental mathematical concepts

AI areas: challenges, questions behind, applications

(1-2 weeks; aa1, aa2, aa4)</td><td></td><td></td><td></td><td></td></tr>
</table>

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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.

Robotics BASIC course structure:

Face-to-Face (F2F)	Online	F2F		Online	F2F	
Day 1		**Day 2**	**Day3**		**Day 4**	**Day 5**
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)*	Solve Project 3a) Solve Project 3b) using Python or EV3 *(270 min; rb6)*
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)*

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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.
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<tr><td rowspan="4">Acquiring required prior knowledge:

Linear algebra

Mechanics, Physics (kinematics 2D, forces, torques)

Programming in Python

(ra1)</td><td>Day 1</td><td rowspan="4">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)</td><td>Day 2</td><td>Day3</td><td rowspan="4">Implementation of the geometrical and kinematical models in Python; open loop (task drive a circle);
(ra1, ra3)

Ethical and social considerations in robotics
(ra6)

(2 weeks)</td><td>Day 4</td><td>Day 5</td></tr>
<tr><td>Getting to know each other. Introduction to EDLRIS.
(45 min; t2,t3,t4)</td><td>Solutions for the inverse geometric model.
(60 min; ra3)</td><td>Mobile Robots: big picture, sensors.
(90 min; ra2, ra3)</td><td>The state Estimator.
(60 min; ra3)</td><td rowspan="3">Practical work with the mobile robot (project: “driver assistant system”).
(270 min; ra4,ra5)</td></tr>
<tr><td>Introduction to Robotics systems.
(140 min; ra2)</td><td>Implementation of the inverse geometric model in Python.
(60 min; ra1, ra3)</td><td>Mobile Robots: the geometrical model.
(90 min; ra3)</td><td>Sensor fusion.
(60 min; ra3)</td></tr>
<tr><td>Geometric model (manipulator; forward kinematics)
(175 min; ra3)</td><td>The manipulator simulator.
(60 min; ra3, ra4)

Experiments with the manipulator: drawing a curve.
(180 min; ra4, ra5)</td><td>Mobile Robots: the kinematical model.
(180 min; ra3)</td><td>PID introduction.
(60min; ra3)

Implementation of the state estimators and PID controllers in Python.
(180 min; ra3)</td><td>Reflect on the teaching methods used in this course and feedback (only for trainers)
(90 min; t1,t2)</td></tr>
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