# ROBOTICS AND INTELLIGENT SYSTEMS PHD PROGRAM
## COURSE SYLLABUS

| Course Details | | | | |
|---|---|---|---|---|
| **Code** | **Academic Year** | | | **Semester** |
| RIS709 | 1 | | | 2 |
| **Title** | **T** | **A** | **L** | **ECTS** |
| Deep Learning | 2 | 2 | 0 | 8 |

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|---|---|---|---|---|---|---|
| **Language** | English | | | | | |
| **Level** | **Undergraduate** | | **Graduate** | **X** | **Postgraduate** | |
| **Department / Program** | Robotics and Intelligent Systems | | | | | |
| **Forms of Teaching and Learning** | | | | | | |
| **Course Type** | **Compulsory** | | **Elective** | **X** | | |
| **Objectives** | The course will give the student the basic ideas and intuition behind a wide range of modern AI systems as well as a formal understanding of how, why, and when they work. The student will gain the ability to use this knowledge in the development of various intelligent systems in the areas of vision, natural language processing and robotics. | | | | | |
| **Content** | Deep Learning, Representation Learning and Generative Learning Using Autoencoders and GANs, Reinforcement Learning | | | | | |
| **Prerequisites** | Recommended: Machine Learning, Intelligent Systems | | | | | |
| **Coordinator** | Dr. techn. Canan YILDIZ | | | | | |
| **Lecturer(s)** | Dr. techn. Canan YILDIZ | | | | | |
| **Assistant(s)** | | | | | | |
| **Work Placement** | | | | | | |

| Recommended or Required Reading | |
|---|---|
| **Books / Lecture Notes** | - Hands-on machine learning with Scikit-Learn, Keras and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurélien Géron, O'Reilly Media, 2019.<br>- Reinforcement Learning, an Introduction, Richard S Sutton, Andrew G. Barto, MIT Press, 2014.<br>- Deep Learning for NLP and Speech Recognition, Uday Kamath, John Liu, James Whitaker, Springer, 2019.<br>- Deep Reinforcement Learning Hands-On , Maxim Lapan, Packt Publishing, 2020. |
| **Other Sources** | - Artificial Intelligence: A Modern Approach, S. Russel und P. Norvig, Prentice Hall, Englewood Cliffs, 2003.<br>- Maschine Learning, Tom Mitchell, McGraw-Hill, 1997.<br>- Deep Learning with TensorFlow 2 and Keras: Regression, ConvNets, GANs, RNNs, NLP, and more with TensorFlow 2 and the Keras API, Antonio Gulli, Amita Kapoor, Sujit Pal, Packt Publishing, 2019.<br>- https://www.davidsilver.uk/teaching/ |

| Additional Course Material | |
|---|---|
| **Documents** | - |
| **Assignments** | - |

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|---|---|---|
| **Exams** | - | |
| **Course Composition** | | |
| **Mathematics und Basic Sciences** | 20 | % |
| **Engineering** | | % |
| **Engineering Design** | | % |
| **Social Sciences** | | % |
| **Educational Sciences** | | % |
| **Natural Sciences** | | % |
| **Health Sciences** | | % |
| **Expert Knowledge** | 80 | % |

**Assessment**

| Activity | Count | Percentage (%) |
|---|---|---|
| **Midterm Exam** | 1 | 40 |
| **Quiz** | | |
| **Assignments** | 1 | 10 |
| **Attendance** | | |
| **Recitations** | | |
| **Projects** | | |
| **Final Exam** | 1 | 50 |
| | **Total** | **100** |

**ECTS Points and Work Load**

| Activity | Count | Duration | Work Load (Hours) |
|---|---|---|---|
| **Lectures** | 14 | 2 | 28 |
| **Self-Study** | 14 | 8 | 112 |
| **Assignments** | 10 | 5 | 50 |
| **Presentation / Seminar Preparation** | | | |
| **Midterm Exam** | 1 | 3 | 3 |
| **Recitations** | 14 | 2 | 28 |
| **Laboratory** | | | |
| **Projects** | | | |
| **Final Exam** | 1 | 3 | 3 |
| | | **Total Work Load** | **224** |
| | | **ECTS Points** (Total Work Load / Hour) | **8** |

**Learning Outcomes**

| | |
|---|---|
| **1** | Understand the complexity of Deep Learning algorithms and their limitations. |

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|---|---|
| **2** | Select the appropriate algorithms for real-life applications. |
| **3** | Be capable of confidently applying common techniques and algorithms in building intelligent systems. |
| **4** | Be capable of performing experiments in Deep Learning using real-world data. |
| **5** | Assess the model quality in terms of relevant performance/error metrics for each application. |
| **Weekly Content** | |
| **1** | Introduction, Efficient Data Representations, |
| **2** | PCA and Stacked Autoencoders |
| **3** | Convolutional Autoencoders, Recurrent Autoencoders, Denoising Autoencoders |
| **4** | Sparse Autoencoders, Variational Autoencoders, Generative Adversarial Networks |
| **5** | Deep Convolutional GANs, Progressive Growing of GANs, Style GANs |
| **6** | Reinforcement Laerning Introduction, Learning to Optimize Rewards |
| **7** | Policy Search, Neural Network Policies, The Credit Assignment Problem, OpenAI Gym |
| **8** | Policy Gradients, Markov Decisin Processes, Temporal Difference Leaning |
| **9** | Midterm |
| **10** | Q-Learning, Exploration Policies, Approximate Q-Learning, Deep Q-Learning, Implementations |
| **11** | Deep Q-Learning Variants, Fixed Q-Value Targets, Double DQN, Prioritized Experience Replay, Dueling DQN |
| **12** | The TF-Agents Library, Training Architectures, Creating and Training Reinforcement Learning Models |
| **13** | Overview of Popular RL Algoritms |
| **14** | Project Presentations |
| **15** | Overview |

**Contribution of Learning Outcomes to Program Objectives (1-5)**

| | P1 | P2 | P3 |
|---|---|---|---|
| **1** | 5 | 5 | 4 |
| **2** | 5 | 5 | 4 |
| **3** | 5 | 5 | 4 |
| **4** | 5 | 5 | 4 |
| **5** | 5 | 5 | 4 |

| | |
|---|---|
| **Contribution Level** | 1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High |
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| **Compiled by:** | Dr. Techn. Canan Yıldız |
| **Date of Compilation:** | 26.05.2021 |