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<tr><th colspan="5">Computational Intelligence</th><th>AR-306</th></tr>
<tr><td>Rota
annually WS</td><td>Duration
1 Semester</td><td>Semester
3rd (Semester)</td><td>SWS
3 SWS</td><td>Credit Points
5</td><td>Workload
150 h</td></tr>
<tr><td>1</td><td colspan="5">Modul structure
<table>
<tr><th>Course (Abbreviation)</th><th>Type/ SWS</th><th>Presence</th><th>Self study</th><th>Credits</th></tr>
<tr><td>a) Computational Intelligence (CI)</td><td>Lecture/ 2 SWS</td><td>30 h</td><td>60 h</td><td>3</td></tr>
<tr><td>b) Computational Intelligence (CI)</td><td>Tutorial/ 1 SWS</td><td>15 h</td><td>45 h</td><td>2</td></tr>
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<tr><td>2</td><td colspan="5">Language: English</td></tr>
<tr><td>3</td><td colspan="5">Content
Since the course covers three different aspects of computational intelligence, the contents can best be described following this division into three parts:
1. Artificial Neural Nets: After a short introduction with reference to the biological paradigm, an introduction to threshold logic sets the basics for neural nets. The most important types of nets are covered namely the perceptron, one- and two-layered nets, and Hopfield nets. Supervised and unsupervised learning is discussed, the backpropagation algorithm and enhancements. The content is presented in a way that emphasis the practical and implementation aspects as well as theoretical considerations like limitations and complexity issues.
2. Evolutionary Algorithms: Again stemming from a natural source of inspiration evolutionary algorithms are introduced as an example from the class of general randomized search heuristics. After a description of the main modules (initialization, selection, crossover, and mutation) comes a discussion of typical parameter settings for population sizes and crossover and mutation probability. Then theoretical aspects are considered, the focus is on the analysis of the expected optimization time. A short introduction into black-box complexity gives a theoretical background for remarks on limitations of this approach.
3. Fuzzy Logic: This final part starts with an introduction to fuzzy sets and fuzzy logic. Fuzzy relations and fuzzy inferences are discussed. Since hybridization is an aspect of increasing importance in practical applications, we build a bridge to the beginning of the course and discuss neuro-fuzzy systems that combine ideas from fuzzy logic with neural nets.
Literature:
• Part 1: Rojas: Neural Networks. A Systematic Introduction. Springer, 2002.
• Part 2: Thomas Bäck: Evolutionary Algorithms in Theory and Practice. Oxford University Press, 1996;
• Thomas Bäck, David Foge, Zbigniew Michalewicz (Eds.): Handbook of Evolutionary Computation; Leila Kallel, Bart Naudts, Alex Rogers (Eds.): Theoretical Aspects of Evolutionary Computing, Springer, 2001.
• Part 3: Hans Bandemer and Siegfried Gottwald: Fuzzy Sets, Fuzzy Logic, Fuzzy Methods with Applications, Wiley 1995;
• Robert Fuller: Introduction to Neuro-Fuzzy Systems, Springer, 2000</td></tr>
<tr><td>4</td><td colspan="5">Goals
Computational Intelligence is used as an umbrella term for different approaches that deliver enhanced performance and applicability. It encompasses artificial neural nets, evolutionary algorithms, and fuzzy logic. This course gives a thorough introduction into all three aspects of computational intelligence from the perspective of computer science. It focuses on theoretical aspects as well as typical application scenarios. After attending the course students are expected to have a basic understanding of the working principles, application areas and limitations of the three approaches.</td></tr>
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5	**Examination Requirements** For credit points homework will be assigned with problems concerning the computational part of the course. Requirements to obtain the credit points are the successful solution of 50 % of the homework, regular attendance at the tutorial, and at least one demonstration of a solution in the tutorial.
6	**Formality of Examination** ☒ Module Finals ☐ Accumulated Grade
7	**Module Requirements (Prerequisites)**
8	**Allocation to Curriculum:** Program: Automation & Robotics, Field of study: Robotics, Process Automation, Cognitive Systems
9	**Responsibility/ Lecturer** *Prof. Dr. G. Rudolph/*Prof. Dr. G. Rudolph