

|   |  |         |    |  |   |                                    |                           |          |                 |   |
|---|--|---------|----|--|---|------------------------------------|---------------------------|----------|-----------------|---|
| <b>Applied Computational Engines: Solving Diverse Computational Problems in Practice</b>  |  |         |    |  |   |                                    | Modulnummer:<br>ME-701.11 |          |                 |   |
| <i>Applied Computational Engines</i>  |  |         |    |  |   |                                    |                           |          |                 |   |
| <b>Master</b><br>Pflicht/Wahl <input type="checkbox"/><br>Wahl <input checked="" type="checkbox"/> Basis <input type="checkbox"/> Ergänzung <input checked="" type="checkbox"/><br>Sonderfall <input type="checkbox"/>  |  |         |    | Zugeordnet zu Masterprofil<br>Basis Ergänzung<br>Sicherheit und Qualität (SQ) <input type="checkbox"/> <input checked="" type="checkbox"/><br>KI, Kognition, Robotik (KIKR) <input type="checkbox"/> <input type="checkbox"/><br>Digitale Medien und Interaktion (DMI) <input type="checkbox"/> <input type="checkbox"/> |   |                                    |                           |          |                 |   |
| Modulbereich: Praktische und Technische Informatik  |  |         |    |  |   |                                    |                           |          |                 |   |
| Modulteilbereich: 701 Rechnerarchitektur  |  |         |    |  |   |                                    |                           |          |                 |   |
| Anzahl der SWS  |  | V       | UE | K  | S | Prak.                              | Proj.                     | $\Sigma$ | Kreditpunkte: 4 | Turnus<br>Bei Interesse in jedem Sommersemester |
|   |  | 2       | 1  | 0  | 0 | 0                                  | 0                         | 3        |                 |   |
| Formale Voraussetzungen: Keine  |  |         |    |  |   |                                    |                           |          |                 |   |
| Inhaltliche Voraussetzungen: Basic theoretical computer science and moderate proficiency of some programming language (for the practical exercises)   |  |         |    |  |   |                                    |                           |          |                 |   |
| Vorgesehenes Semester: ab 1. Semester   |  |         |    |  |   |                                    |                           |          |                 |   |
| Sprache: Englisch   |  |         |    |  |   |                                    |                           |          |                 |   |
| Ziele: To be able to identify when difficult computational problems that can occur in the computer scientist's working life can be solved by standard computational engines.<br>To know the strenghts and limits of a diverse set of computational engines, such as SAT solving, QBF solving, and linear programming.<br>To be able to apply some commonly used computational engines to a wide variety of decision and optimization problems.  |  |         |    |  |   |                                    |                           |          |                 |   |
| Inhalte: Topics include: <ul style="list-style-type: none"> <li>• SAT Solving (Basic algorithms for SAT solving: unit propagation, backtracking, variable selection, and learning; Tseitin encoding and alternatives; SAT encodings in practice; Theory of tractability: "Backdoors")</li> <li>• Quantified Boolean Formula (QBF) solving</li> <li>• Integer Linear Programming (ILP) and Linear Programming (LP) as an "easy" subset (Definitions &amp; encodings, Extension: Quadratic programming)</li> <li>• SMT solving (Basic idea and algorithms, SMT encodings of complex problems)</li> <li>• Supporting the encoding of difficult problems (Delta debugging &amp; fuzz testing)</li> <li>• BDDs</li> <li>• Maximum flow algorithms &amp; their applications</li> <li>• Automata for PSPACE-complete problems</li> <li>• Sub-engineering problems (clustering, ...)</li> <li>• Robust problem solving: games of infinite duration</li> <li>• Applied branch-and-bound</li> </ul> |  |         |    |  |   |                                    |                           |          |                 |   |
| Unterlagen (Skripte, Literatur, Programme usw.): <ul style="list-style-type: none"> <li>• Armin Biere, Marijn Heule, Hans van Maaren, Toby Walsh (eds.): Handbook of Satisfiability, IOS Press, 2009</li> <li>• Donald E. Knuth: The Art of Computer Programming (Volumes 1-4A), Addison Wesley, 2014</li> <li>• Jon Kleinberg, Eva Tardos: Algorithm Design, 2006</li> </ul>   |  |         |    |  |   |                                    |                           |          |                 |   |
| Form der Prüfung:<br>i.d.R. Bearbeitung von Übungsaufgaben und Fachgespräch oder mündliche Prüfung  |  |         |    |  |   |                                    |                           |          |                 |   |
| Arbeitsaufwand  |  | Präsenz |    | 42 h   |   | Übungsbetrieb/Prüfungsvorbereitung |                           | 78 h     |                 |   |
|   |  | Summe   |    | 120 h  |   |                                    |                           |          |                 |   |

Lehrende:  
Rüdiger Ehlers

Verantwortlich:  
Rüdiger Ehlers