Modulbezeichnung	**Applied Computational Engines**
Modulverantwortliche(r)	Rüdiger Ehlers
Modulart	Pflicht/Wahl ☐ Wahlpflicht ☒
Spezialisierungsbereich	Systemsoftware / Eingebettete Systeme
Dauer des Moduls	1 Semester
Kreditpunkte	4 CP
Arbeitsaufwand	Berechnung des Workloads Präsenz 42 h Übungsbetrieb/Prüfungsvorbereitung 78 h Summe 120 h
Turnus des Moduls	Bei Interesse in jedem Sommersemester
Voraussetzung für die Teilnahme	Keine ☐ Folgende: Formale Voraussetzungen: KeineInhaltliche Voraussetzungen: Basic theoretical computer science and moderate proficiency of some programming language (for the practical exercises)
Lehr- und Lernformen	Seminar ☐ Vorlesung ☒ Tutorium ☒ Praktikum ☐ Projekt ☐
Lernziele	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. To know the strenghts and limits of a diverse set of computational engines, such as SAT solving, QBF solving, and linear programming. To be able to apply some commonly used computational engines to a wide variety of decision and optimization problems.
Lerninhalte	Topics include: • 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") • Quantified Boolean Formula (QBF) solving • Integer Linear Programming (ILP) and Linear Programming (LP) as an "easy" subset (Definitions & encodings, Extension: Quadratic programming) • SMT solving (Basic idea and algorithms, SMT encodings of complex problems) • Supporting the encoding of difficult problems (Delta debugging & fuzz testing) • BDDs • Maximum flow algorithms & their applications • Automata for PSPACE-complete problems • Sub-engineering problems (clustering, . . .) • Robust problem solving: games of infinite duration • Applied branch-and-bound
Prüfungsformen	i.d.R. Bearbeitung von Übungsaufgaben und Fachgespräch oder mündliche Prüfung

Literatur	• Armin Biere, Marijn Heule, Hans van Maaren, Toby Walsh (eds.): Handbook of Satisfiability, IOS Press, 2009 • Donald E. Knuth: The Art of Computer Programming (Volumes 1-4A), Addison Wesley, 2014 • Jon Kleinberg, Eva Tardos: Algorithm Design, 2006