TECHNISCHE UNIVERSITÄT
ILMENAU

Modulhandbuch

Master

Research in Computer and Systems Engineering

Studienordnungsversion: 2021

gültig für das Wintersemester 2023/24

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Inhaltsverzeichnis

TECHNISCHE UNIVERSITÄT ILMENAU

Modul: Advanced Database Systems

Modulabschluss: Prüfungsleistung schriftlich 60 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Pflichtmodul Turnus:Wintersemester

Modulnummer: 200037 Prüfungsnummer:2200680

Modulverantwortlich: Prof. Dr. Kai-Uwe Sattler

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):116 SWS:3.0

Fakultät für Informatik und Automatisierung Fachgebiet:2254

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
	2	1	0																											

Lernergebnisse / Kompetenzen

Nach dem Besuch dieser Veranstaltung verstehen die Studierenden die fortgeschrittene Prinzipien von Datenbanksystemen. Sie kennen die Schritte des Entwurfs von Datenbanken und können die relationale Entwurfstheorie erläutern. Die Studierenden sind in der Lage, gegebene praktische Problemstellungen zu analysieren, im ER-Modell zu modellieren und in einer relationalen Datenbank abzubilden. Weiterhin können sie deklarative Anfragen in Relationenalgebra und SQL formulieren sowie Integritätsbedingungen definieren. Die Studierenden kennen die Aufgaben und Prinzipien der einzelnen DBMS-Komponenten sowie deren Zusammenwirken. Sie können verschiedene Techniken zur Speicherung und Verwaltung großer Datenbestände sowie zur Verarbeitung von Anfragen und Transaktionen erklären und bewerten.

Durch die Übungen können die Studierenden eigene Lösungen zu gestellten Aufgaben präsentieren, sich an themenspezifischen Diskussionen beteiligen und sind in der Lage, Fragen zu beantworten.

Vorkenntnisse

Foundations of Computer Science and particularly Data Management

Inhalt

Introduction; Conceptual Modeling: Entity-Relationship Model, Mapping ER Schemas to Relations; Relational Database Theory: Functional Dependencies, Normal Forms, Relational Model and Relational Algebra; SQL and Database Programming; Storage and File Structures: Indexing, B-Trees; Query Processing: Query Operators, Query Optimization; Transaction Processing & Recovery, Serializability, Locking, Locking, Recovery Strategies

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Vorlesung mit Präsentation und Tafel, Handouts, Moodle

Literatur

Garcia-Molina, Ullman, Widom: Database Systems - The Complete Book, Pearson/Prentice Hall, 2009

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/enrol/index.php?id=167

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Modul: Control Engineering

Modulabschluss: Prüfungsleistung schriftlich 90 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Pflichtmodul Turnus:Wintersemester

Modulnummer: 200007 Prüfungsnummer:2200637

Modulverantwortlich: Prof. Dr. Pu Li

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2212

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
	2	2	0																											

Lernergebnisse / Kompetenzen

Die Studierenden können

- die Grundlagen, Problemstellungen und Methoden der Regelungs- und Systemtechnik/technische Kybernetik klassifizieren,
- Systembeschreibungen ableiten,
- Methoden zur Systemanalyse anwenden,
- die Stabilität sowie einschleifige Regelkreise für industrielle Prozesse analysieren.

Die Studierenden haben in der Vorlesung die Theorie, Modelle und Methoden zu den genannten Sachverhalten erfahren. In den Übungen wurden sie durch Beispiele angesprochen.

The students are able to

- classify the fundamentals, problems, and methods of control and systems engineering/technical cybernetics,
- derive system descriptions,
- apply methods of system analysis, and
- analyze stability and single control loops of industrial processes.

The students have learned learn the theory, models, and methods of the corresponding subjects in the lectures. In the exercises, they had been activated to solve example tasks.

Vorkenntnisse

Grundlagen der Mathematik, Physik, Elektrotechnik, Maschinenbau

Inhalt

Modeling of linear processes:

- Modeling with differential equations
- Linearization of nonlinear systems
- State space model

Laplace transformation:

- Laplace transformation of typical functions
- Properties of Laplace transformation
- Transfer function

Analysis of control systems in time domain:

- Dynamics of different plants
- Responses due to typical input signals

- Functions of typical controller

Stability analysis

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Video on Demand, Moodle-Kurs, Webex-Veranstaltungen, Folien, Skripte

Literatur

R. C. Dorf, R. H. Bishop. Modern Control Systems. Pearson. 2005
K. Ogata. Modern control engineering. Pearson. 2010

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Modul: Software & Systems Engineering

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Pflichtmodul | Turnus: Wintersemester

Modulnummer: 200055 | Prüfungsnummer: 220443

Modulverantwortlich: Prof. Dr. Armin Zimmermann

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 116 | SWS: 3.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2236

SWS nach Fachsemester

1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
2	1	0																											

Lernergebnisse / Kompetenzen

After the lectures, students understand advanced problems and solution approaches for the design of complex software systems. They know how to acquire and handle functional and non-functional requirements and are able to draw design decisions from them. The exercises and home works teach the students to choose and apply the right model-based design and evaluation method for application problems and their non-functional properties. Students can independently understand advanced topics in systems and software engineering from background literature and are able to solve problems and document results.

Vorkenntnisse

Bachelor in Computer Science, Computer Engineering or equivalent

Inhalt

Introduction to advanced topics in Software Engineering and Systems Engineering.

Introduction and Overview of Topics
Systems Engineering
Selected Topics in Software Engineering
Selected Topics in Model-Based Systems Engineering (Performance Evaluation)

RCSE students have priority for the available slots

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentation slides
Literature notes
Lecture recordings
Home work tasks

Literatur

Sommerville: Software Engineering
M. Ajmone Marsan, G. Balbo, G. Conte, S. Donatelli and G. Franceschinis: Modelling with Generalized Stochastic Petri Nets
INCOSE Systems Engineering Handbook
Blanchard, Fabrycky: Systems Engineering and Analysis
Cassandras/Lafortune: Introduction to Discrete Event Systems

Detailangaben zum Abschluss

Das Modul Software & Systems Engineering mit der Prüfungsnummer 220443 schließt mit folgenden Leistungen ab:

- schriftliche Prüfungsleistung über 90 Minuten mit einer Wichtung von 70% (Prüfungsnummer: 2200701)
- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 30% (Prüfungsnummer: 2200702)

Details zum Abschluss Teilleistung 2:
Assessments of Home work tasks

Link zum Moodle-Kurs

Course page: https://moodle.tu-ilmenau.de/course/view.php?id=806
Exercise page: https://moodle.tu-ilmenau.de/course/view.php?id=807

verwendet in folgenden Studiengängen:

Master Medieningenieurwissenschaften 2023
Master Medientechnologie 2017
Master Research in Computer and Systems Engineering 2021

Modul: Advanced Mobile Communication Networks

Modulabschluss: Prüfungsleistung schriftlich 90 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Pflichtmodul Turnus:Sommersemester

Modulnummer: 200068 Prüfungsnummer:2200718

Modulverantwortlich: Prof. Dr. Andreas Mitschele-Thiel

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2235

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	0																								

Lernergebnisse / Kompetenzen

. Fachkompetenz: Die Studierenden verfügen nach der Vorlesung über Kenntnisse und Wissen zu Aufbau und Funktionsweise von Mobilkommunikationsnetzen, insbesondere IP-basierter mobiler drahtloser Systeme und deren Protokolle, sowie Kenntnisse des Zusammenspiels verschiedener Funktionen.

. Methodenkompetenz: Die Studierenden sind in der Lage, komplexe Fragestellungen IP-basierter Mobilkommunikationssysteme und ihrer Funktionen zu verstehen und dieses Verständnis selbständig zu vertiefen.

. Systemkompetenz: Durch die Kombination aus Vorlesung und der Bearbeitung umfangreicher Testfragen zur Vertiefung des Stoffes verstehen die Studierenden im Anschluss das Zusammenwirken der verschiedenen Komponenten und Protokollfunktionen des Systems und können den Einfluss von Entwurfsentscheidungen bei der Realisierung von Protokollfunktionen auf andere Funktionen und das System als Ganzes einschätzen.

. Sozialkompetenz: Die Studierenden sind in der Lage, Problemstellungen der Mobilkommunikation selbständig zu lösen und darzustellen. Durch Diskussionen der Antworten zu unserem umfangreichen Fragekatalog haben Sie gelernt, Meinungen anderer Studierender zu beachten und diese kritisch zu hinterfragen. Das für die Lösung der Aufgaben benötige Wissen konnten sie sich selbständig bzw. in Zusammenarbeit mit anderen aus verfügbaren Quellen erarbeiten, wurden sich durch die Präsentation der verschiedenen Möglichkeiten der Herangehensweise bei der Problemlösung bewusst und sind in der Lage die Leistungen Anderer entsprechend zu würdigen.

Vorkenntnisse

Bachelor degree, basics of communication networks

Inhalt

- Introduction to mobile communications with focus on protocols and systems
- Basics of wireless transmission
- Media access schemes
- Mobility management
- Transport protocols
- Quality-of-Service
- Security
- Communication systems (802.11, GSM/GPRS, UMTS)

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations

Literatur

Jochen Schiller Mobilkommunikationsnetze (for details see intro-slide) and further literature

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=373

verwendet in folgenden Studiengängen:

Master Communications and Signal Processing 2021
Master Informatik 2013
Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021

Modul: Algorithms

Modulabschluss: Prüfungsleistung schriftlich 90 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Pflichtmodul Turnus:Sommersemester

Modulnummer: 200080 Prüfungsnummer:2200734

Modulverantwortlich: Prof. Dr. Christoph Berkholz

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):116 SWS:3.0

Fakultät für Informatik und Automatisierung Fachgebiet:2242

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	1	0																								

Lernergebnisse / Kompetenzen

The students know the basic principles of the design and the analysis of algorithms: correctness and running time. They know the Big-O notation and its use for analyzing running times. They know basic number theoretical algorithms (addition, multiplication, division, modular multiplication, modular exponentiation, greatest common divisor), they know basic primality tests and the RSA encryption scheme. The students know the divide-and-conquer paradigm with the master theorem (and its proof) and the most important examples like Karatsuba's algorithm, Strassen's algorithm, Mergesort, Quicksort, and the Fast Fourier Transform. They know basic techniques for orienting oneself in graphs and digraphs: BFS, DFS, Kosaraju's algorithm for strongly connected components. They know Dijkstra's algorithm for calculating shortest paths in graphs, and the data type priority queue with its most important implementation techniques "binary heap" and "d-ary heap". Out of the family of greedy algorithms they know Kruskal's algorithm and Prim's algorithm for the problem of a mimimum spanning tree, including the correctness proof and the runtime analysis including the use of the union find data structure. As another greedy algorithm they know Huffman's algorithm for an optimal binary code. In the context of the dynamic programming paradigm the students know the principal approach as well as the specific algorithms for Edit distance, all-pairs shortest paths (Floyd-Warshall), single-source shortest paths with edge lengths (Bellman-Ford), knapsack problems and matrix chain multiplication. They know the basic definitions and facts from NP-completeness theory, in particular the implications one gets (if P <> NP) from the fact that a search problem is NP-complete as well as central examples of NP-complete problems.

Methodenkompetenz: The students can formulate the relevant problems and can describe the algorithms that solve the problems. They are able to carry out the algorithms for example inputs, to prove correctness and analyze the running time. They are able to apply algorithm paradigms to create algorithms in situations similar to those treated in the course. They can explain the significance of the concept of NP-completeness and identify some selected NP-complete problems.
Sozialkompetenz: The international students, coming from different countries and different backgrounds, have experienced and trained working together despite of such differences. The lectures make it necessary to respect the right of all other students to a concentrated working atmosphere, while being open for discussion of the subject matter. The students can participate in the discussion of the material in an organized manner. The students can participate actively and interactively in the discussion of the exercise problems in the discussion sessions. They have also experienced the possibility of different approaches to an algorithmic problem within the rules of the game and the state of the art. The (voluntary) practice sessions further have improved the students' ability to explore and assess the significance of the theoretical results of the lecture.

Vorkenntnisse

Basic Data Structures, Calculus, Discrete Structures

Inhalt

Fibonacci numbers and their algorithms, Big-O notation, multiplication, division, modular addition and multiplication, fast exponentiation, 8extended) Euclidean algorithm, primality testing by Fermat's test (with proof) and by Miller-Rabin (without proof), generating primes, cryptography and the RSA system (with correctness proof and runtime analysis). The divide-and-conquer scheme, Karatsuba multiplication, the master theorem (with proof), Mergesort, Quicksort, polynomial multiplication and Fast Fourier Transform. Graph representation. Exploring graphs and digraphs by BFS and (detailed) DFS. Acyclicity test (with proof), topological ordering. Strongly connected components by Kosaraju's algorithm (with proof). Shortest paths by Dijkstra's

algorithm (with proof), priority queues as auxiliary data structure. The greedy paradigm. Minimum spanning trees by Kruskal's algorithm (with union-find data structure) and the Prim/Jarnik algorithm (with correctness proof). Huffman encoding, with priority queue, correctness proof. The dynamic programming paradigm. Examples: edit distance, chain matrix multiplication, knapsack with and without repetition, shortest paths (Floyd-Warshall and Bellman-Ford). Polynomial search problems, class NP, NP-complete problems. Significance of the notion. Central examples: Satisfiability, Clique, vertex cover, traveling salesperson, graph coloring.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

zum Moodle-Kurs
Blackboard, slide projection, exercise sheets, Moodle platform for communication

Literatur

- S. Dasgupta, C. H. Papadimitriou, U. V. Vazirani, Algorithms, McGraw Hill, 2006 (Prime textbook)
- T. Cormen, C. Leiserson, R. Rivest, C. Stein, Introduction to Algorithms, Second Edition, MIT Press 2001
- Sedgewick, Algorithms, Addison Wesley (Any edition will do, with or without specific programming language.)

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Modul: Research Skills

Modulabschluss: Studienleistung alternativ | Art der Notengebung: Testat / Generierte

Sprache:Englisch | Pflichtkennz.:Pflichtmodul | Turnus:ganzjährig

Modulnummer: 200036 | Prüfungsnummer:2200679

Modulverantwortlich: Prof. Dr. Armin Zimmermann

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):128 | SWS:2.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2236

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
	0	2	0																											

Lernergebnisse / Kompetenzen

Students understand the basics of knowledge creation in engineering sciences. They know how to define a research topic, how to search for relevant literature, and why and how to cite. Methods: They learned to write research papers, how to review them, and can present results in talks with slides and posters. Soft skills: a major part of the class was a self-organized scientific workshop, for which the students have submitted papers, reviewed them, took part and organizeed the event including management and conference chairing (publication, web pages, finances, ...). Participants know how to organize a scientific event and how to collaborate in the organization in different roles.

Vorkenntnisse

keine

Inhalt

The course is organized in three parts: a tutorial part where we study how to write research papers, review papers, design conference posters, write research proposals, and organize workshops and conferences. The second part is practical training, where every student will apply the new knowledge and will write and review papers, design conference posters, and take an active part in organizing a conference.
The concluding event will be the Annual RCSE Conference on Computer and Systems Engineering (CCSE) at the end of the term, which will be fully organized by the course participants.
Course topics are

- Reading and writing papers
- Presenting scientific work
- Designing conference posters
- Writing research proposals
- Reviewing papers
- Organizing workshops and conferences.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Lecture slides
Recorded lectures
Links to additional reading material

Literatur

see Web pages

Detailangaben zum Abschluss

- Seminar Presentation
- Committee work
- Paper submission

- Paper reviews
- Paper/Poster presentation

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=337

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Lehrveranstaltung aus dem aktuellen Katalog(Wahl von Modulen aus dem aktuellem Katalog)

Fachabschluss: Prüfungsleistung | Art der Notengebung: Gestufte Noten

Sprache: | Pflichtkennz.:Wahlmodul | Turnus:ganzjährig

Fachnummer: 0000 | Prüfungsnummer:90201

Fachverantwortlich:

Leistungspunkte: 0 | Workload (h):0 | Anteil Selbststudium (h):0 | SWS:0.0

Fakultät für Informatik und Automatisierung | Fachgebiet:22

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P

Lernergebnisse / Kompetenzen

Vorkenntnisse

Inhalt

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Literatur

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Diplom Maschinenbau 2017
Diplom Maschinenbau 2021
Bachelor Medienwirtschaft 2015
Master Wirtschaftsingenieurwesen 2014 Vertiefung BT
Master Elektrotechnik und Informationstechnik 2014 Vertiefung MNE
Master Optische Systemtechnik 2022
Master Wirtschaftsingenieurwesen 2021 Vertiefung MB
Master Allgemeine Betriebswirtschaftslehre 2013
Bachelor Medientechnologie 2021
Master Wirtschaftsingenieurwesen 2015 Vertiefung MB
Master Micro- and Nanotechnologies 2021
Master Biotechnische Chemie 2023
Master Informatik 2021
Bachelor Mathematik 2013
Bachelor Technische Physik 2023
Diplom Elektrotechnik und Informationstechnik 2021
Master Wirtschaftsinformatik 2021
Master Media and Communication Science 2021
Master Fahrzeugtechnik 2022
Master Mechatronik 2022
Master Wirtschaftsingenieurwesen 2011

Bachelor Wirtschaftsinformatik 2021
Bachelor Fahrzeugtechnik 2021
Bachelor Informatik 2021
Master Electric Power and Control Systems Engineering 2021
Bachelor Technische Kybernetik und Systemtheorie 2013
Bachelor Ingenieurinformatik 2021
Master Wirtschaftsingenieurwesen 2021 Vertiefung AT
Master Ingenieurinformatik 2014
Master Maschinenbau 2022
Bachelor Werkstoffwissenschaft 2013
Bachelor Mathematik 2021
Master Biotechnische Chemie 2020
Master Research in Computer and Systems Engineering 2016
Master Medienwirtschaft 2018
Bachelor Medieningenieurwissenschaften 2023
Bachelor/Lehramt Polyvalenter Bachelor mit Lehramtsoption für berufsbildende Schulen - Elektrotechnik 2013
Master Elektrotechnik und Informationstechnik 2014 Vertiefung AST
Master Wirtschaftsingenieurwesen 2014 Vertiefung MB
Master Technische Kybernetik und Systemtheorie 2014
Master Biomedizinische Technik 2021
Bachelor/Lehramt Polyvalenter Bachelor mit Lehramtsoption für berufsbildende Schulen - Elektrotechnik 2013
Master Technische Physik 2013
Master Wirtschaftsingenieurwesen 2021
Master Medieningenieurwissenschaften 2023
Master Biomedizinische Technik 2014
Bachelor Maschinenbau 2021
Bachelor Ingenieurinformatik 2013
Master Research in Computer & Systems Engineering 2016
Bachelor Biotechnische Chemie 2013
Master Mathematik und Wirtschaftsmathematik 2022
Bachelor Angewandte Medien- und Kommunikationswissenschaft 2021
Master Wirtschaftsinformatik 2018
Master Wirtschaftsinformatik 2014
Bachelor/Lehramt Polyvalenter Bachelor mit Lehramtsoption für berufsbildende Schulen - Metalltechnik 2013
Master Ingenieurinformatik 2021
Master Mathematik und Wirtschaftsmathematik 2013 Vertiefung AM
Bachelor Technische Physik 2013
Master Medienwirtschaft 2021
Master Wirtschaftsingenieurwesen 2018 Vertiefung MB
Master Technische Kybernetik und Systemtheorie 2021
Master Optische Systemtechnik/Optronik 2017
Master Elektrotechnik und Informationstechnik 2021
Master Wirtschaftsingenieurwesen 2014
Master Research in Computer and Systems Engineering 2021
Master Communications and Signal Processing 2021
Bachelor/Lehramt Polyvalenter Bachelor mit Lehramtsoption für berufsbildende Schulen - Metalltechnik 2013
Master Micro- and Nanotechnologies 2016
Bachelor Medienwirtschaft 2021
Diplom Elektrotechnik und Informationstechnik 2017
Bachelor Wirtschaftsingenieurwesen 2015 Vertiefung MB
Bachelor Mechatronik 2021
Bachelor Elektrotechnik und Informationstechnik 2021
Master Medien- und Kommunikationswissenschaft/Media and Communication Science 2013
Bachelor Biotechnische Chemie 2021
Master Elektrotechnik und Informationstechnik 2014 Vertiefung IKT
Bachelor/Lehramt Polyvalenter Bachelor mit Lehramtsoption für berufsbildende Schulen - Elektrotechnik 2013
Bachelor Informatik 2013
Master Elektrotechnik und Informationstechnik 2014 Vertiefung ATE
Bachelor Wirtschaftsingenieurwesen 2015 Vertiefung ET
Master Maschinenbau 2017
Master Wirtschaftsingenieurwesen 2021 Vertiefung ET
Bachelor Elektrotechnik und Informationstechnik 2013

Bachelor Wirtschaftsingenieurwesen 2021 Vertiefung MB
Master Wirtschaftsingenieurwesen 2018
Bachelor Technische Kybernetik und Systemtheorie 2021
Master Elektrochemie und Galvanotechnik 2021
Master Medientechnologie 2017
Bachelor Werkstoffwissenschaft 2021
Master Wirtschaftsingenieurwesen 2013
Bachelor Angewandte Medien- und Kommunikationswissenschaft 2014
Bachelor Betriebswirtschaftslehre mit technischer Orientierung 2021
Bachelor/Lehramt Polyvalenter Bachelor mit Lehramtsoption für berufsbildende Schulen - Metalltechnik 2013
Master Technische Physik 2023
Master Communications and Signal Processing 2013
Bachelor Medientechnologie 2013
Master Medienwirtschaft 2014
Bachelor Biomedizinische Technik 2021
Master Elektrotechnik und Informationstechnik 2014 Vertiefung EET
Master Wirtschaftsingenieurwesen 2015 Vertiefung BT
Master Wirtschaftsinformatik 2015
Master Regenerative Energietechnik 2022
Bachelor Optische Systemtechnik/Optronik 2013
Master Wirtschaftsingenieurwesen 2018 Vertiefung BT
Master Wirtschaftsingenieurwesen 2010
Master Wirtschaftsingenieurwesen 2013 Vertiefung BT
Master Mathematik und Wirtschaftsmathematik 2013 Vertiefung WM
Bachelor Wirtschaftsingenieurwesen 2021 Vertiefung ET
Master Wirtschaftsingenieurwesen 2015
Master Wirtschaftsingenieurwesen 2021 Vertiefung BT
Master Medienwirtschaft 2015
Master Werkstoffwissenschaft 2021
Master Informatik 2013
Master Regenerative Energietechnik 2016
Master International Business Economics 2021

Modul: Advanced Computer Graphics

Modulabschluss: Prüfungsleistung alternativ | Art der Notengebung: Gestufte Noten

Sprache:Englisch | Pflichtkennz.:Wahlmodul | Turnus:Sommersemester

Modulnummer: 200058 | Prüfungsnummer:2200706

Modulverantwortlich: Prof. Dr. Patrick Mäder

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):105 | SWS:4.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2252

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	0																								

Lernergebnisse / Kompetenzen

Students of this class have the motivation and ability to apply several patterns of geometrical algorithms and data structures as well as mathematical simulation models in other fields than computer graphics. They got experiences in modeling geometry, color, light propagation and textures. They learned that the choice of an appropriate coordinate system is important for the quality of a model/a solution. The students have knowledge in the basics of real time rendering. They also have experiences in the implementation of rendering software for simple 3d models as well as approaches for rendering massive 3D data and/or massive amounts of light sources. They are able to implement global illumination approaches using modern graphics hardware. Students are experienced in shader development with focus on WebGL and understood the main parts of modern rendering pipelines. They are able to differentiate use cases and to select adequate rendering strategies like deferred shading.

Vorkenntnisse

Recommended are fundamentals in the fields of vector analysis (2D and 3D) and JavaScript, but at course begin there will be also the possibility to close gaps in those fields.

Inhalt

- Vector geometry basics (Cartesian and homogeneous coordinates in 2D and 3D) for transformations and projections, incl. application in modeling of geometric objects and scenes as well as for different kinds light propagation simulation
- Generation of simple 2D-Graphics in HTML-Canvas elements
- Vertex and fragment shader programming in WebGL, incl. performance tests on different harware
- Color spaces, direct shading approaches, approaches for occlusion and transparency handling, texture mapping
- Efficient data structures for global real time illumination of massive 3D data
- Global illumination approaches (e.g. Radiosity, Raytracing and Photon Tracing)
- Deferred Shading

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

- Lecture and seminar slides, exercise sheets
- Program skeletons (to be extended in exercises / homework)
- Opencast lecture recordings
- Assigments and seminar tasks shared via Moodle
- All material will be shared via Moodle. The following link refers to the currently active course: https://www.tu-ilmenau.de/modultafeln/?fnqall=200058.

Technical Requirements

- personal computer (or at least a tablet device) required for all seminars and assignments as well as the exams

Literatur

- Computer graphics : principles and practice / John F. Hughes et al., 3rd ed., 2014, https://opac.lbs-ilmenau.

gbv.de/DB=1/XMLPRS=N/PPN?PPN=739291289

- https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API
- https://www.khronos.org/files/webgl/webgl-reference-card-1_0.pdf
- https://www.pbr-book.org (free online book for further reading)

Detailangaben zum Abschluss

Details zum Abschluss:

- one or multiple written tests consisting of multiple-choice and free-form questions evaluating the professional competence in the course's topics
- one or multiple assignments to be solved individually at home and turned-in via Moodle at a defined due date announced with the task
- final results may be scaled or individual questions may be excluded depending on best performing percentile of students
- exam result determined as average across individual tests and assignments
- all activities preferably conducted digitally via Moodle and on the student's device
- students must register via Thoska for this exam, typically within the 3rd and 4th week of the semester

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Informatik 2013
Master Medieningenieurwissenschaften 2023
Master Medientechnologie 2017
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Complex Embedded Systems

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Sommersemester

Modulnummer: 200016 | Prüfungsnummer: 220431

Modulverantwortlich: Prof. Daniel Ziener

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 116 | SWS: 3.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2231

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	1	0																								

Lernergebnisse / Kompetenzen

Students understand structure and functions of complex embedded systems. They understand requirements and design aspects with respect to real time, communication, and software architecture issues. Participants are able to take into account safety, reliability, timing, and performance requirements and know kow to design embedded systems with guarantees. Methods: students are able to apply methods of model-based systems and software design and hardware/software codesign to given design problems. They master different modeling and design methods and can decide which one fits a given problem setting. Practical skills: students have learned and trained to design and implement a small embedded system. Soft skills: Students can discuss design options and successfully work as a team to develop an embedded system

Vorkenntnisse

Finished 1st semester courses of RCSE, especially software & systems engineering; general knowledge of Bachelor-level computer science

Inhalt

1. Introduction, Motivation
2. Aspects of System Design
3. Model-Based Design
4. Real-Time Systems
5. Scheduling
6. Safety and Reliability
7. Software Design for Embedded Systems
8. Hardware-Software-Codesign
9. Computer Architecture of Embedded Systems
10. Communication Systems
11. Energy Consumption
12. Automotive Embedded Systems

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Slides available on the Moodle page
Blackboard notes
Video lecture of 2020
Links to additional optional learning material in the Moodle page

Literatur

Wolf: Computers as Components
Burns and Wellings: Real-time systems and programming languages
Liu: Real-Time Systems
Cooling: Software engineering for real-time systemsadditional literature, especially for individual student talks, is given in the lecture

Detailangaben zum Abschluss

Das Modul Complex Embedded Systems mit der Prüfungsnummer 220431 schließt mit folgenden Leistungen ab:

- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 30% (Prüfungsnummer: 2200650)
- schriftliche Prüfungsleistung über 90 Minuten mit einer Wichtung von 70% (Prüfungsnummer: 2200651)

Details zum Abschluss Teilleistung 1:
Lab project on embedded systems in small groups

Details zum Abschluss Teilleistung 2:
written exam

Link zum Moodle-Kurs

Slides available on the Moodle page https://moodle2.tu-ilmenau.de/course/view.php?id=580
Information for the lab: https://moodle2.tu-ilmenau.de/course/view.php?id=4711

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Computer-Aided Diagnosis and Therapy

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Sommersemester

Modulnummer: 201174 | Prüfungsnummer: 220497

Modulverantwortlich: Prof. Dr. Sylvia Saalfeld

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 105 | SWS: 4.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2257

SWS nach Fachsemester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	0																								

Lernergebnisse / Kompetenzen

Students will be able to understand and apply basic processing algorithms for computer-aided diagnosis and therapy.
The students are able to evaluate methods of computer support with regard to the reliability of results, the plausibility check by the user, the comprehensibility and the interpretability of computer-supported applications by medical experts.
The students are able to present a scientific application area in a lecture to the group. They are able to evaluate presentations on the basis of evaluation criteria.

Vorkenntnisse

Image processing

Inhalt

The course "Computer-Aided Diagnosis and Therapy" focuses on diseases, their detection and treatment. These medical aspects will be discussed using a number of relevant examples, including heart disease, lung disease, and tumor disease. Requirements for computer assistance are derived and examples of such systems are presented. Computer support is often used to automatically detect suspicious regions or to better inform therapeutic decisions. The focus is not on algorithmic details, but on the evaluation of computer support from a clinical point of view. This includes questions of reliability of results, plausibility checks by users, comprehensibility and interpretability of computer-aided visualizations by medical experts. Integration into clinical processes also plays an important role. In this course, the corresponding exercise will take place in the form of a seminar, in which individual topics of the lecture will be deepened and further interesting research work will be presented and discussed.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations, Handout, Moodle

Literatur

A list of references with scientific papers will be provided at the end of each lecture

Detailangaben zum Abschluss

Das Modul Computer-Aided Diagnosis and Therapy mit der Prüfungsnummer 220497 schließt mit folgenden Leistungen ab:

- mündliche Prüfungsleistung über 20 Minuten mit einer Wichtung von 100% (Prüfungsnummer: 2200872)
- alternative semesterbegleitende Studienleistung mit einer Wichtung von 0% (Prüfungsnummer: 2200873)

Details zum Abschluss Teilleistung 2: short presentation on a topic

Link zum Moodle-Kurs

https://moodle2.tu-ilmenau.de/course/view.php?id=4817

verwendet in folgenden Studiengängen:

Master Biomedizinische Technik 2021

Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Data-Driven Optimization for Machine Learning Applications

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Sommersemester

Modulnummer: 200135 | Prüfungsnummer: 220491

Modulverantwortlich: Prof. Dr. Pu Li

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 105 | SWS: 4.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2212

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	0																								

Lernergebnisse / Kompetenzen

The students know and can explain

- basic model-driven, model-driven data-augumented, and data-driven optimization
- numerical linear algebra methods for machine learning
- convexity and regularization of functions
- non-negative matrix factorization and application
- modern mathematical optimization algorithms for pattern recognition and classification
- modern mathematical optimization algorithms for neural-network-based modeling.

They can implement

- optimization algorithms for linear and nonlinear regressions
- quadratic programming methods for support vector machines
- optimization algorithms for non-negative matrix factorization, pattern recognition, and applications
- and evaluate various optimization algorithms for neural network-based modeling and applications

The students learn the theory, models, methods, and algorithms of the corresponding subjects in the lectures. In the exercises, they are activated to solve example tasks. In project tasks, they analyze, solve, and evaluate programming problems.

Vorkenntnisse

BSc level. Basic linear algebra and computer programming skills are advantageous.

Inhalt

1. Introduction - Motivation, Data-driven versus Model-driven appraoch, importance of data-driven optimization; overview of optimization problems arising in machine learning applications;
2. Preiminaries - linear algebra; convex sets convex functions; gradient, sub-gradient, hessian matrix;
3. Programming basics (Python, R, Matlab); data loading and preprocessing;
4. Unconstrained optimization for machine learning: regularization-meaning and relevance; regression problems; neural networks and back-propagation of errors; optimization methods for deep learning ;

5. Uncostrained Optimiztion Algorithms; 5A: First-order algorithms - gradient descent, accelerated gradient descent, stochastic gradient descent, conjugate gradient methods, coordinate descent; R and Python implementations; sub-gradient methods (optional); 5B. Second-order algorithms: The Newton Method; quasi-Newton methods; LBFGS; R and Python implementations;

6. Constrained Optimization Methods for Machine Learning - the interior point method; face-recongintion with supprot vector machine using Python, Scikit-Learn and OpenCV ;Matrix factorization methods for pattern recognition- SVD, PCA, non-negative matrix factorization (NMF); Matlab and Python Scikit-Learn implementations; Proximal-Point Algorithms: proximal gradient methods; alternating direction of multupliers (ADMM);
7. Bayesian Optimization methods for Machine Learning;
8. Optimization algorithms in Deep Learning Tools TensorFlow, Kerays, pyTorch

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Lecture Slides, PC Pools, Machine Learning Tools and Libraries

Literatur

Bottou, Léon; Curtis Frank E., Nocedal, Jorge: Optimization Methods for Large-Scale Machine Learning. SIAM Review, 60(2), 223-
311.

Emrouznejad, Ali (ed.): Big Data Optimization: Recent developments and challenges. Volume 18, Studies in Big Data Series, Springer,
2016.
Geron, Aurelien: Hands-on machine learning with scikit-learn, Keras & TensorFlow, 2nd Ed. O'Reilly,
2019. Goodfellow, Ian; Bengio, Yoshua; Courville, Aaron: Deep Learning. The MIT Press,
2017.

Detailangaben zum Abschluss

Das Modul Data-Driven Optimization for Machine Learning Applications mit der Prüfungsnummer 220491 schließt mit folgenden Leistungen ab:

- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 30% (Prüfungsnummer: 2200829)
- mündliche Prüfungsleistung über 30 Minuten mit einer Wichtung von 70% (Prüfungsnummer: 2200830)

Details zum Abschluss Teilleistung 1:
Programmieraufgaben als Hausbeleg

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Diplom Elektrotechnik und Informationstechnik 2021
Master Elektrotechnik und Informationstechnik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016
Master Technische Kybernetik und Systemtheorie 2021

Modul: Discrete Event Systems

Modulabschluss: Prüfungsleistung schriftlich 120 min | Art der Notengebung: Gestufte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Sommersemester

Modulnummer: 200089 | Prüfungsnummer: 2200751

Modulverantwortlich: Prof. Dr. Yuri Shardt

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 105 | SWS: 4.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2211

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	0																								

Lernergebnisse / Kompetenzen

By the end of this course, students should be able to describe and analyze important properties of discrete-event systems in the form of automata; to design simple supervisors for typical closed-loop system specifications; and to reduce the complexity of the design task, using modular and decentralized as well as hierarchical design methods. Furthermore, the students should have learnt how to develop and implement solutions that require the analysis and control of automata for real-world problems. They should have learnt to constructively take criticism and implement comments and suggestions from their instructors and fellow students.

Vorkenntnisse

Foundational knowledge in mathematics and control theory

Inhalt

The course will cover:

· Features of event-driven processes

· Formal languages and automata

· Automaton features

· The concept of supervisory control

· Controllability and blocking of automata

· Minimally restrictive supervisor design · Modular and decentralized approaches

· Hierarchical design procedures

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations, Course notes, and Whiteboard lectures, online according to the regulations of TU Ilmenau, Moodle

Literatur

· C. Cassandras, S. Lafortune, Introduction to Discrete Event Systems, Springer, 2008.

· F. Puente Le?on, U. Kiencke, Ereignisdiskrete Systeme: Modellierung und Steuerung verteilter Systeme, Oldenbourg, 2013.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Diplom Elektrotechnik und Informationstechnik 2021

Master Elektrotechnik und Informationstechnik 2014 Vertiefung AST
Master Elektrotechnik und Informationstechnik 2021
Master Ingenieurinformatik 2014
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016
Master Technische Kybernetik und Systemtheorie 2021

TECHNISCHE UNIVERSITÄT
ILMENAU

Modul: Distributed Data Management

Modulabschluss: Prüfungsleistung schriftlich 90 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Sommersemester

Modulnummer: 200138 Prüfungsnummer:2200833

Modulverantwortlich: Prof. Dr. Kai-Uwe Sattler

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):116 SWS:3.0

Fakultät für Informatik und Automatisierung Fachgebiet:2254

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	1	0																								

Lernergebnisse / Kompetenzen

Nachdem Studierende diese Veranstaltung besucht haben, kennen sie die Prinzipien und Verfahren verteilter und paralleler Datenmanagementlösungen. Sie verstehen die Prinzipien dieser Techniken und können darauf aufbauend selbst Lösungen entwickeln. Die Studierenden können Techniken zur Anfrageverarbeitung, Replikation und Konsistenzsicherung erklären und hinsichtlich ihrer Vor- und Nachteile für verschiedene Einsatzzwecke bewerten.

Sie sind in der Lage, verteilte und parallele Datenbanken zu entwerfen und aktuelle Datenbanktechnologien verteilter und paralleler Systeme zu bewerten und anzuwenden.
Mit den Übungen können die Studierenden eigene Lösungen zu gestellten Aufgaben präsentieren, sich an themenspezifischen Diskussionen beteiligen und sind bereit, Fragen zu beantworten.

Vorkenntnisse

Vorlesung Datenbanksysteme, Transaktionale Informationssysteme

Inhalt

Einführung und Motivation; Grundlagen verteilter Datenbanken: Architektur und Datenverteilung, verteilte Anfrageverarbeitung, Replikationsverfahren; Parallele Datenbanksysteme: Architektur und Datenverteilung, parallele Anfrageverarbeitung, Shared-Disk-Systeme; Web-Scale Data Mangement: SaaS und Multi Tenancy, Virtualisierungstechniken, Konsistenzmodelle, QoS, Partitionierung, Replikation, DHTs, MapReduce

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Vorlesung mit Präsentationen und Tafel, Handouts, Moodle

Literatur

Rahm, Saake, Sattler: Verteiltes und Paralleles Datenmanagement: Von verteilten Datenbanken zu Big Data und Cloud, Springer Vieweg, 2015
Lehner, Sattler: Web-Scale Data Management for the Cloud, Springer, 2013

M. Tamer Özsu, P. Valduriez: Principles of Distributed Database Systems, 3. Auflage, Springer, 2011

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Informatik 2013
Master Informatik 2021

Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016
Master Wirtschaftsinformatik 2021

Modul: Distributed Systems

Modulabschluss: Prüfungsleistung mündlich 30 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Sommersemester

Modulnummer: 201172 Prüfungsnummer:2200869

Modulverantwortlich: Prof. Dr. Boris Koldehofe

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2255

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				3	1	0																								

Lernergebnisse / Kompetenzen

At the end of the course, the students can independently reproduce, explain, and relate central problems and approaches of distributed systems and corresponding algorithms.
They show a deep understanding and a broad knowledge of fundamental distributed algorithms and programming paradigms that enable them to explain their properties and to demonstrate, analyze, and prove their behavior taking various criteria into account.
Their detailed knowledge allows the students to interpret models and abstractions of distributed systems. They can self-dependently select appropriate mechanisms to deal with communication delays and failures. The student can compare the suitability of algorithms for specific distributed systems scenarios.
They can explain the limitations of distributed systems concepts for different system properties, e.g., for synchronous and asynchronous systems or in the context of different failure models.
The students can relate findings of distributed systems principles to applicable and exemplary knowledge of current developments, e.g., blockchains, in-network computing, or data management.

Vorkenntnisse

Pre-Knowledge on fundamental aspects in computing science obtained for instance in a BSc-Program computing science, in particular

- Data structures and algorithms, Complexity Analysis
- Basic concepts of Programming Languages
- Basic knowledge on Computer Networks, Computer Architecture or Operating System Principles

Inhalt

Distributed systems: definition, classes, architecture
Models and abstractions for correctness, time and failures in distributed systems
Basic distributed systems services: IPC, Naming, Clocks
Reasoning about state in distributed systems: global state
Coordination problems and distributed algorithms: transaction processing, replication
Fundamental distributed algorithms: reliable broadcast, consensus

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Slides
Lecture Recording
Exercise Assignments & Solutions
Quizzes
Blackboard Discussion

Literatur

G. F. Coulouris, J. Dillimore, T. Kindberg. Distributed Systems: Concepts And Design. 5th Ed. 2017. ISBN 978-9332575226.
M. van Steen, A. S. Tanenbaum. Distributed Systems. Ed. 3.01. 2017. ISBN 978-1543057386.
P. Bernstein, V. Hadzilacos, N. Goodman. Concurrency Control and Recovery in Database Systems. Ed. 4.3. 1987. ISBN 0-201-10715-5.
C. Cachin, V. Hadzilacos, N. Goodman. Introduction to Reliable and Secure Distributed Programming. Ed. 2. 2011. ISBN 978-3-642-15259-7.
K. Birman. Reliable Distributed Systems: Technologies, Web Services, and Applications. Ed. 1. 2006. ISBN

9780387276014.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle2.tu-ilmenau.de/course/view.php?id=4713

verwendet in folgenden Studiengängen:

Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Fuzzy Control

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Sommersemester

Modulnummer: 201138 | Prüfungsnummer: 220495

Modulverantwortlich: Prof. Dr. Yuri Shardt

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 94 | SWS: 5.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2211

SWS nach Fachsemester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	1																								

Lernergebnisse / Kompetenzen

By the end of the course, students should be able to understand and analyse fuzzy-based systems. They should be able to design special fuzzy systems for control engineering applications (fuzzy controllers). From the lectures, they have learnt the theoretical foundations of selecting and parameterising problem-adapted fuzzy components (membership functions, operators, etc), designing different types of fuzzy controllers, implementing control specifications (overshoot, settling time, etc.) by changing the parameter settings; and the application of different nonlinear optimisation methods, such as evolution strategy and heuristic search, for controller design. Furthermore, they have learnt how to design knowledge-based systems in control applications such as fuzzy controllers and the effects of individual system components on the way the controller works. From the lectures and laboratories, the students have learnt how to develop solutions for the design of fuzzy controllers by working on practice questions and by completing the laboratory. Furthermore, the laboratory has provided the students with greater appreciation and understanding of the applications of fuzzy controllers in real systems, as well as some of the challenges in such applications.

Vorkenntnisse

System Identification, Control

Inhalt

·Introduction to the Concept of Fuzzy Systems and their Relationship with Everyday Life
·Foundations of Fuzzy-Control Theory
·Modelling of Fuzzy Systems
·Characteristics of Fuzzy Systems
·Optimal Design of Fuzzy Controllers
·Adaptive Fuzzy Ideas
·Applications of Fuzzy Systems and Controllers in industrial systems
·Software Used: Fuzzy Logic Toolbox for MATLAB

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations, Course notes, and Whiteboard lectures, Online-Video-System, Moodle

Literatur

Fuzzy Logik, Neuronale Netze und Evolutionäre Algorithmen Shaker Verlag, Aachen 2005.

Kiendl H.: Fuzzy Control methodenorientiert, Oldenbourg, München 1997.
Piegat A.: Fuzzy Modeling and Control, Germany, Heidelberg: Physica-Verlag 2001.

Schöneburg E., Heinzmann F., Fedderson S.: Genetische Algorithmen und Evolutionsstrategien, Addison-Wesley, 1994.
Rechenberg I.: Evolutionsstrategie '94, frommann-holzboog, 1994

Detailangaben zum Abschluss

Das Modul Fuzzy Control mit der Prüfungsnummer 220495 schließt mit folgenden Leistungen ab:

- schriftliche Prüfungsleistung über 120 Minuten mit einer Wichtung von 100% (Prüfungsnummer: 2200865)
- Studienleistung mit einer Wichtung von 0% (Prüfungsnummer: 2200866)

Link zum Moodle-Kurs

https://moodle2.tu-ilmenau.de/course/view.php?id=3463

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Security in Embedded Systems

Modulabschluss: Prüfungsleistung schriftlich 90 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Wintersemester

Modulnummer: 200134 Prüfungsnummer:2200828

Modulverantwortlich: Prof. Daniel Ziener

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2231

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

Learning Goals

- The students have knowledge about types of attacks.
- The students have knowledge about detection of atacks.
- The students have knowledge about prevention of attacks.
- The students have knowledge about countermeasures against attacks.

Expertise
. The students can show the influence of attacks and the corresponding countermeasures on the dependability of embedded systems
. The students can describe the different countermeasures of attacks
. The students can summarize different security facilities and measures for embedded systems
. The students can show the overhead (area, time) of security facilities
. The students can classify different types of attack on embedded systems

Social Competence
. The students can develop concepts in groups with subsequent implementations
Autonomy
. The students can acquire new knowledge from specific literature and associate this knowledge with other classes.

Vorkenntnisse

computer engineering, basic knowledge in embedded systems

Inhalt

Background:
Due to increasing networking of embedded systems, the protection of such systems against attacks on stored or processed data as well as implementation details is an increasingly important but also challenging task. The protection of embedded systems against known as well as new sophisticated attack possibilities is the subject of this lecture. It shows what attacks exist, what countermeasures can be taken and how to design secure embedded systems.

Course coverage:

- Attack scenarios
  - Examples of attack scenarios
  - Attacks on cryptographic algorithms and their implementations
- Code injection attacks
  - Different type of code injection attacks
  - Countermeasures
- Invasive physical attacks

    - Microprobing
    - Prevention and detection of single event effects
    - Reverse engineering
    - IP Protection
    - Watermarking
- Non-invasive logical attacks
    - Phishing
    - Forged authenticity
    - Countermeasures
- Non-invasive physical attacks
    - Eavesdroping
    - Side-channel attacks
- Case study: Security in automotive applications

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Slides (presentation+download), exercises (download), examples

Technische Anforderungen bei alternativen Lehrleistungen in elektronischer Form:
Internetzugang, Mikrofon+Lautsprecher oder Headset, Webex Meeting
(bei Abschlussleistung: zusätzlich Kamera)

Literatur

- Catherine H. Gebotys, Security in Embedded Devices. Springer 2010.
- Benoit Badrignans et al., Security Trends for FPGAs. Springer 2011.
- Daniel Ziener, Techniques for Increasing Security and Reliability of IP Cores Embedded in FPGA and ASIC Designs. Dr. Hut 2010.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=275

verwendet in folgenden Studiengängen:

Master Informatik 2013
Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2016
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: System Identification

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Sommersemester

Modulnummer: 200090 | Prüfungsnummer: 220459

Modulverantwortlich: Prof. Dr. Yuri Shardt

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 105 | SWS: 4.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2211

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	1	1																								

Lernergebnisse / Kompetenzen

By the end of this course, students should be able to understand the principles of creating models for complex processes using different methods and approaches. From the lectures, they will have learnt linear regression, nonlinear regression, design of experiments, and time series analysis, while from the laboratory, they will have learnt to apply the system identification framework to solve relevant modelling and identification problems. From the lectures and laboratories, the students should have learnt how to develop and implement solutions that require the use of statistics, linear regression, and experimental design for real-world problems. They should have learnt to constructively take criticism and implement comments and suggestions from their instructors and fellow students.

Vorkenntnisse

Knowledge in "Control Engineering I" and "Model Building"

Inhalt

The course content is:

1. Data Visualisation

2. Statistical Tests

3. Linear Regression

4. Nonlinear Regression

5. Design of Experiments

6. Time Series Analysis

Laboratory (2 Visits: HSS-1: Identification I; HSS-2: Identification II)

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations, Course notes, and Whiteboard lectures, online according to the regulations of TU Ilmenau, Moodle

Literatur

· Y.A.W. Shardt, Statistics for Chemical and Process Engineers: A Modern Approach, Springer, 2015, https://doi.org/10.1007/978-3-319-21509-9.

· L. Ljung, System Identification: Theory for the user, Prentice Hall, 1999.

Detailangaben zum Abschluss

Das Modul System Identification mit der Prüfungsnummer 220459 schließt mit folgenden Leistungen ab:

- schriftliche Prüfungsleistung über 120 Minuten mit einer Wichtung von 100% (Prüfungsnummer: 2200752)
- Studienleistung mit einer Wichtung von 0% (Prüfungsnummer: 2200753)

Details zum Abschluss Teilleistung 2:
Pass for the laboratory component

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Diplom Elektrotechnik und Informationstechnik 2017
Master Fahrzeugtechnik 2022
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: System Security

Modulabschluss: Prüfungsleistung mündlich 20 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Sommersemester

Modulnummer: 200033 Prüfungsnummer:2200675

Modulverantwortlich: Prof. Dr. Kai-Uwe Sattler

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2255

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				3	1	0																								

Lernergebnisse / Kompetenzen

Students are able to define and derive security requirements from application scenarios (lecture). They can define and use the term "security policy" (lecture). Students are able to apply formal security models to represent a security policy (lecture and exercises). For this, they can define, classify and compare fundamental security models (lecture and exercises). Based on this, students can evaluate such models against security properties (lecture and exercises) and construct new, application-specific models (exercises). They can name essential languages and mechanisms for implementing such models (lecture) and apply them to case studies (exercises). Security architectures used for integrating secuity mechanisms can be described and classified by the students (lecture). They can also assess their suitability for specific use cases (exercises).

Students can discuss open questions and argue for different solution approaches. They can prepare theoretical and practical assignments for the exercises and present their results. They can coordinate cooperative work on complex home assignments.

Vorkenntnisse

Mandatory: Basic knowledge of operating systems, software engineering and formal automata and computability.
Crucial prerequisites will be briefly revisited when necessary.
Recommended: Basic knowledge of computer networks, discrete mathematics, predicate logic and algorithms and complexity.

Inhalt

This module focuses on the basic paradigms, methods and concepts in the field of model-based security engineering - the methodical process of engineering a computer system's security properties based on formal security models. In an early stage of the engineering process formal security models are used for the precise and unambiguous representation of security policies which then are analyzed by static model checking and simulative model execution. Successful models afterwards are transformed via specification languages into executable code which finally is integrated into a system's trusted computing base.
Topics are

- Requirements analysis
- Security policies and formal security models
- Model engineering and analysis
- Domain-specific model specification languages
- Security mechanisms
- Security architectures

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations with projector and whiteboard, books, papers, assignments, discussions

Literatur

William Stallings, Lawrie Brown: Computer Security. Pearson, 2nd Edition, 2012, 810 pages.
Matthew Bishop: Computer Security: Art and Science. Addison-Wesley Educational Publishers Inc, 2012 (2. Edition), 1168 pages.
Trent Jaeger: Operating System Security. Synthesis Lectures on Information Security, Privacy and Trust #1, Morgan & Claypool Publishers, 2008.
N. Akosan et. al.: Mobile Platform Security. Synthesis Lectures on Information Security, Privacy and Trust #9, Morgan & Claypool Publishers, 2014.
Anupam Datta et. al.: Analysis Techniques for Information Security. Synthesis Lectures on Information Security, Privacy and Trust #2, Morgan & Claypool Publishers, 2010.
Ross Anderson: Security Engineering. John Wiley & Sons, 2nd Edidtion, 2008, 1040 pages. Also available online.
Frank Mayer, Karl Macmillan, David Caplan: SELinux by Example. Prentice Hall 2007, 425 pages.
Bruce Schneier: Secrets and Lies - Digital Security in a Networked World. John Wiley & Sons 2000, 408 pages.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle2.tu-ilmenau.de/course/view.php?id=2473

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Advanced Computer Architectures

Modulabschluss: Prüfungsleistung mündlich 30 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Wintersemester

Modulnummer: 201198 Prüfungsnummer:2200876

Modulverantwortlich: Dr. Bernd Däne

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):116 SWS:3.0

Fakultät für Informatik und Automatisierung Fachgebiet:2231

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							3	0	0																					

Lernergebnisse / Kompetenzen

Learning outcomes and competencies from the lecture:

Technical competence: Students understand in detail common features, distinguishing criteria, areas of application, structure and operation of microcontrollers and digital signal processors. The students know structure and function mode of selected typical representatives. Students understand the functions of software tools used in typical development processes for microcontrollers and digital signal processors.
Students understand in detail general characteristics, advantages and disadvantages, significance, structure, function and possible applications of the special and innovative computer architectures covered. The students recognize the mode of operation of selected individual functions on the basis of exemplary demonstrations.

Methodological competence: The students are able to analyze the properties and possible applications of microcontrollers and digital signal processors and to assess their suitability for different tasks. Students are able to plan and implement the use of microcontrollers and digital signal processors using manufacturer information.
Students should be able to analyze special and innovative computer architectures, evaluate their possible applications, and recognize their classification within the computer architectures covered.
System competence: Students recognize the relationship between architecture and application in the field of microcontrollers and digital signal processors. Students understand the importance of microcontrollers and digital signal processors in the context of the realization of embedded systems.
Students should be able to recognize the diversity and evolution of computer architectures as part of overall technological advancement.

Social competence: Students are able to follow a lecture in a concentrated and attentive manner and to avoid interruptions. They recognize the appropriate times to ask questions.

In addition to lecture, source-based independent study is used as another form of learning.

Learning outcomes and competencies from independent study:

Professional competence: Students have expanded their knowledge of the subject matter covered using source material. They have acquired further individual knowledge and have deepened the knowledge they have acquired in the lecture.

Methodological competence: The students are able to find suitable and reliable information in the literature and on the Internet. They are able to classify the information they find and link it to the knowledge they have already acquired. They are also able to recognize the necessity of a study of sources based on a concrete task or question and to carry this out appropriately.
System competence: Students have deepened their understanding of the classification and significance of the individual architectures discussed within the overall view of computer architectures.

Social competence: The students have a balance between independent, concentrated work and the exchange with others.

Vorkenntnisse

Basic knowledge of computer architectures and computer engineering from related Bachelor courses.

Inhalt

Topics of the lecture:
1. Introduction
2. Microcontrollers and Digital Signal Processors
3. Vector Computers 4. Processing in Memory
5. Other Aspects of Control Flow Architectures
6. Dataflow Architectures
7. Neurocomputers
8. Optical Computers
9. Quantum Computing

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

- blackboard/whiteboard
- slides (video projection)

Literatur

Online sources for further information (in case of special interest) will be provided in the Moodle course.
Reading literature is not required in this course.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=279
(Key: 1234)

verwendet in folgenden Studiengängen:

Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021

Modul: Advanced Distributed Systems

Modulabschluss: Prüfungsleistung mündlich 30 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Wintersemester

Modulnummer: 201197 Prüfungsnummer:2200875

Modulverantwortlich: Prof. Dr. Boris Koldehofe

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2255

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							3	1	0																					

Lernergebnisse / Kompetenzen

At the end of the course, students can reproduce and explain concepts for dealing with dynamic and large-scale distributed systems. Students show a deep understanding of system concepts to ensure performance, robustness, and security of distributed applications. Students can explain the properties of specific concepts for autoscaling and securing distributed applications and demonstrate, analyze, and prove their behavior. Students are able to interpret and use different models and abstractions of advanced distributed systems and select appropriate mechanisms for dealing with highly heterogenous components from the continuum of resources comprising IoT devices, edge resources, cloud resources, and network components. The student can compare the suitability of algorithms and mechanisms for specific advanced distributed systems applications, reason about their limitations, and can relate the findings to particular use cases, e.g., the Internet of Things and scalable data analysis.

Vorkenntnisse

Pre-knowledge on fundamental aspects of computer science obtained for instance in a BSc program, in particular data structures and algorithms, basic concepts of programming languages, basic knowledge on computer networks, computer architecture or distributed and operating system principles.

Inhalt

Nowadays, distributed systems are highly dynamic and often integrate many heterogeneous resources for computing communication and storage over a continuum of cloud data centers, edge data centers, user devices, sensors, and network components. In this course, students will study the principles behind current distributed technologies and modern architectures that support building highly scalable and robust distributed applications. The goal of the course is to develop an understanding of the principles behind advanced distributed systems technologies and programming concepts to build scalable, robust, and secure distributed systems applications. In particular, the lecture will cover the following topics:

1) Modern technologies and architectural concepts of distributed systems covering principles behind cloud, edge, fog, serverless and in-network computing
2) Systematic study of autoscaling concepts for distributed systems
3) Accelerating the performance of distributed systems with hardware accelerators and new system concepts, e.g., P4, DPDK, and RDMA
4) Advanced distributed programming concepts supporting scalable and robust distributed systems, e.g., asynchronous communication, distributed ledgers, distributed machine learning
5) Advanced security and privacy mechanisms, e.g., differential privacy, attribute-based encryption, distributed authentication and authorization architectures and federated learning

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Slides
Lecture Recording
Exercise Assignments & Solutions
Quizzes
Blackboard Discussion

Literatur

The literature list provides pointers for complementary reading only and will be updated before the start of the course:

• Frank Fitzek, Fabrizio Granelli, Patrick Seeling. Computing in Communication Networks: From Theory to Practice. Academic Press. 2020. ISBN ? 978-0128204887
• Thomas Ertl. Cloud Computing: Concepts, Technology, and Architecture. Pearson 2023. ISBN 978-0138052256.
• G. F. Coulouris, J. Dillimore, T. Kindberg. Distributed Systems: Concepts And Design. 5th Ed. 2017. ISBN 978-9332575226.
M. van Steen, A. S. Tanenbaum. Distributed Systems. Ed. 3.01. 2017. ISBN 978-1543057386.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=804

verwendet in folgenden Studiengängen:

Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021

Modul: Cellular Communication Systems

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Wintersemester

Modulnummer: 200070 | Prüfungsnummer: 220447

Modulverantwortlich: Prof. Dr. Andreas Mitschele-Thiel

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 105 | SWS: 4.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2235

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

Technical competence:
After completion of the lectures, students will have knowledge and understanding of the structure and operation of modern cellular mobile communication systems, in particular GSM, GPRS/EDGE, UMTS, LTE and 5G and their protocols.

Methodological competence:
Students are able to understand complex issues of cellular mobile communication systems, to deepen this understanding independently and to develop their own solutions based on this.

Systems Competency:
Through a combination of lecture and individual work, students will subsequently understand the interaction of the components and individual functions of the system and be able to assess the impact of design decisions on the system as a whole.

Social Competence:
Students are able to independently solve and showcase problems of cellular mobile communication systems. By developing their own proposed solutions for selected topics individually, as well as presenting and discussing them in the group, they have learned to take other students' opinions into account and to critically question them. They were able to acquire the knowledge required for solving the tasks from available sources independently or in cooperation with others, became aware of the approach for problem solution through the presentation of the different possibilities and are able to appreciate the achievements of others accordingly.

Vorkenntnisse

Communication protocols and networks, basics of mobile communication networks

Inhalt

- Review of mobile communication basics
- Overview on GSM and GPRS
- UMTS architecture (mobility management, connection and session management, wideband CDMA, management of radio resources
- UMTS radio access network
- High-Speed Packet Access (HSPA)
- Long-Term Evolution (LTE)
- System Architecture Evolution (SAE)
- Self-organization in LTE

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations with beamer, presentation slides

Literatur

- Kaaranen, Ahtiainen, Laitinen, Naghian, Niemi. UMTS Networks - Architecture, Mobility and Services. Wiley, 2001
- Holma, Toskala. WCDMA for UMTS. revised edition, Wiley, 2002
- Dahlmann, Parkvall, Sköld. 4G: LTE/LTE-Advanced for Mobile Broadband, AP, 2011
- Stefania Sesia, Issam Toufik, Matthew Baker. LTE - The UMTS Long Term Evolution: From Theory to Practice

Detailangaben zum Abschluss

Das Modul Cellular Communication Systems mit der Prüfungsnummer 220447 schließt mit folgenden Leistungen ab:

- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 40% (Prüfungsnummer: 2200720)
- mündliche Prüfungsleistung 20 Minuten mit einer Wichtung von 60% (Prüfungsnummer: 2200721)

Details zum Abschluss Teilleistung 1:
The course consists of two parts: In the first part of the semester, lectures on the material are given. In the second part, individual studies (semester-long research projects that include a term paper and a presentation) help to improve understanding of the material.

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=372

verwendet in folgenden Studiengängen:

Master Communications and Signal Processing 2021
Master Informatik 2013
Master Informatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Communication Networks

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: Englisch | Pflichtkennz.: Wahlmodul | Turnus: Wintersemester

Modulnummer: 200497 | Prüfungsnummer: 210483

Modulverantwortlich: Prof. Dr. Jochen Seitz

Leistungspunkte: 10 | Workload (h): 300 | Anteil Selbststudium (h): 232 | SWS: 6.0

Fakultät für Elektrotechnik und Informationstechnik | Fachgebiet: 2115

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							4	2	0																					

Lernergebnisse / Kompetenzen

Telecommunication is an integral part of today's life. People are used to communicate with any person they would like to by phone, e-mail, chat, or skype at any place at any time. Students in this lecture have learned the basic characteristics of different communication networks. In a bottom-up approach, starting from the physical medium going up to the application, they are familiar with the functionality of different communication protocols and understand how these cooperate to achieve a communication service. Hence, they know different aspects of quality of service the users can expect from different protocols, and are able to specify protocols on their own based on the according protocol mechanisms. As the lecture deals with different networks (telephone network, Internet, mobile communication networks, broadband access networks), the students can characterize these networks and explain the differences.

After the lectures and exercises, the students are able to write a report on a current topic in the area of communication networks, which counts 20 % of the final grade. After this report, the students are familiar with investigating new scientific publications on communication protocols and networks from different sources and know how to judge the relevance of different publications. Furthermore, they have developed their competencies in academic writing.

Vorkenntnisse

keine speziellen Vorkenntnisse notwendig

Inhalt

1. Introduction: Definitions, History of Telecommunications, Trends
2. Fundamentals: Communications Services, Protocols and Protocol Functions
3. Protocol Specification: Extended Finite State Machines, Message-Sequence-Charts
4. Transmission Technique: Signals, Physical Medium, Coding, Multiplexing
5. Interconnection of Networks: Repeaters, Hubs, Bridges, Switches, Routers, Gateways
6. Switching Technology: Cicuit Switching, Store and Forward, Message Switching, Packet Switching, Virtual Circuit, Datagram Switching
7. The Internet: IPv4/IPv6, Routing, Transport Layer, Applications
8. Digital Subscriber Line: xDSL
9. Public Land Mobile Networks: GSM & GPRS, UMTS, LTE, 5G
10. Wireless Communication: WLAN (IEEE 802.11), Bluetooth, Mobile Ad hoc Networks
11. Automotive Communications: IEEE 802.11p, WAVE
12. Delay Tolerant Networks

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

PowerPoint-Folien, Tafelanschrieb, Seminaraufgaben, Kontrollfragen zur Prüfungsvorbereitung, Hausarbeit

Literatur

- Halsall, Fred (2000): Data Communications, Computer Networks and Open Systems. 4th edition, reprint.

Harlow: Addison-Wesley (Electronic Systems Engineering Series).

• Kurose, James F.; Ross, Keith W. (2017): Computer Networking. A Top-Down Approach. 7th edition. Hoboken, New Jersey: Pearson.

• Peterson, Larry L.; Davie, Bruce S. (2012): Computer Networks. A Systems Approach. 5th edition. Amsterdam: Morgan Kaufmann (The Morgan Kaufmann Series in Networking).

• Stallings, William (2014): Data and Computer Communications. 10th edition. Upper Saddle River, N.J.: Pearson.

• Tanenbaum, Andrew S.; Wetherall, David J. (2011): Computer Networks. 5th edition. Boston: Pearson Prentice Hall.
plus weitere themenspezifische Quellen

Detailangaben zum Abschluss

Das Modul Communication Networks mit der Prüfungsnummer 210483 schließt mit folgenden Leistungen ab:
- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 20% (Prüfungsnummer: 2100827)
- schriftliche Prüfungsleistung über 90 Minuten mit einer Wichtung von 80% (Prüfungsnummer: 2100828)

Details of examination part 1:
Recherchehausarbeit über ein aktuelles Thema aus dem Bereich der Kommunikationsnetze auf Englisch. Themen werden zu Beginn der Vorlesungszeit vorgeschlagen. Abgabe einer Ausarbeitung im Umfang von max. 6 Seiten spätestens in der letzten Vorlesungswoche. Eine nicht abgegebene Ausarbeitung wird mit der Note 5 bewertet. Die Note einer bestandenen Recherchehausarbeit behält bis zum Bestehen der schriftlichen Abschlussprüfung ihre Gültigkeit. Die Teilleistung wird nur im Wintersemester begleitend zur Lehrveranstaltung angeboten.

Research paper on a current topic in the field of communication networks in English. Topics are suggested at the beginning of the lecture period. Submission of a paper of max. 6 pages at the latest in the last week of lectures. A paper that is not handed in will be assessed with a grade of 5. The grade of a passed research paper remains valid until the written final examination is passed. The partial performance is only offered in the winter semester accompanying the lecture.

Details of examination part 2:
Written exam, 90 minutes

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Communications and Signal Processing 2021
Master Medieningenieurwissenschaften 2023
Master Medientechnologie 2017
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Data Storage Systems

Modulabschluss: Prüfungsleistung mündlich 30 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Sommersemester

Modulnummer: 201094 Prüfungsnummer:2200859

Modulverantwortlich: Prof. Dr. Kai-Uwe Sattler

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):116 SWS:3.0

Fakultät für Informatik und Automatisierung Fachgebiet:2254

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	1	0																								

Lernergebnisse / Kompetenzen

After attending the lecture, the students know the principles, methods, and applications of large, distributed data storage systems. They are able to explain important components and principles of data storage systems, such as storage devices, interfaces & protocols, file systems, storage tiering & caching, and deduplication & compression. The students are able to select and apply software tools and methods to analyze and understand the internal processes of data storage systems regarding their functioning and performance.
Participating in the lecture enables the students to evaluate and assess methods and components of data storage systems. They are qualified to design complete data storage system architectures and implement parts of the data storage system in software based on concrete usage requirements.
As part of the practical exercises, the students can present own solutions to specific tasks, participate in topic-specific discussions, and develop parts of data storage systems alone or in small groups.

Vorkenntnisse

An undergraduate-level understanding of maths, programming, data structures & algorithms, operating systems, and distributed systems is assumed.

Inhalt

1 Introduction (History of storage, difierent kinds of storage, applications;evolution in terms of capacity, performance, and price)

2 Storage Device Hardware and Firmware (Internal organization of storage hardware (e.g., HDDs, SSD); Disk scheduling; SSD FTL components)

3 Protocols & Interfaces (NVMe; SATA, PCIe)

4 Linux I/O Stack (Filesystems layer (incl. VFS); storage device layer)

5 File Systems (Files, directories, and file access methods; disk layout strategies (e.g., inodes, etc.))

6 Benchmarking & I/O Performance Analysis (fio, filebench, basic terms: througput, latency, IOPS; blktrace)

7 I/O Performance Enhancements (Parallel I/O Programming)

8 Replication & Crash Recovery (Mirroring, RAID, Erasure Coding)

9 Storage Tiering & Caching (Storage Hierarchy; Cache eviction strategies)

10 Data Deduplication (difierences to compression, techniques)

11 Distributed & Parallel File Systems (distributed: AFS & NFS, Google FS as scalable example; parallel: Lustre, GFS/GPFS)

12 Key-Value Stores (LSM (e.g., RocksDB); distributed: Amazon Dynamo)

13 Object Storage Systems & Cloud Storage (openStack Swift; S3; Azure Storage; Facebook f4)

14 Recent trends in storage systems & novel storage hardware (Computational Storage; Zoned Storage; SMR disks; NVM; DNA & glass)

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Lecture with presentations and blackboard (for face-to-face courses), flipped classroom (recorded videos and seminar-like discussions of the topics via videoconf for virtual teaching), Moodle

Literatur

This is an incomplete list of various interesting and useful books that will be touched during the course. You need to consult them occasionally.

. Remzi H Arpaci-Dusseau und Andrea C Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform, 2018.

. Alex Petrov, Database Internals: A deep-dive into how distributed data systems work, O'Reilly, 2019.

. Andrew S Tanenbaum, Modern Operating Systems, Pearson, 2014.

. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Distributed Systems: Concepts and Design, Pearson, 2011

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Deep Learning

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache:Englisch | Pflichtkennz.:Wahlmodul | Turnus:ganzjährig

Modulnummer: 200131 | Prüfungsnummer:220488

Modulverantwortlich: Prof. Dr. Patrick Mäder

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):105 | SWS:4.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2252

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				2	2	0																								

Lernergebnisse / Kompetenzen

Professional competence gained through lectures and examined through written exam:

- Students have knowledge about theoretical foundations of deep neural networks.
- Students have knowledge about CNN architectes and their applications.
- Students have knowledge about architectures for sequence modeling and their applications.

Methodological competence gained through seminars and examined through aPl (assignments):

- Students gained the ability to implement and apply a variety of deep learning algorithms.
- Students gained the ability to evaluate and troubleshoot deep learning models.
- Students gained the ability to use computational resources for training and application of deep learning models.

Social competence gained through lectures and seminars:

- Students gained insights in ethical aspects of machine learning (e.g., bias, autonomous driving) through discussions in lectures and seminars.
- Students can discuss advantages and disadvantages of different deep learning approaches among each other and with their lecturers and gained professionality in mastering discussions beyond their mother tongue.
- Students learn to discuss and solve a scientific problem in a team of peers

Vorkenntnisse

- basic programming skills in Python
- basic understanding of machine learning preferable

Inhalt

Deep learning has recently revolutionized a variety of application like speech recognition, image classification, and language translation mostly driven by large tech companies, but increasingly also small and medium-sized companies aim to apply deep learning techniques for solving an ever increasing variety of problems. This course will give you detailed insight into deep learning, introducing you to the fundamentals as well as to the latest tools and methods in this rapidly emerging field.
Deep learning thereby refers to a subset of machine learning algorithms that analyze data in succeeding stages, each operating on a different representation of the analyzed data. Specific to deep learning is the ability to automatically learn these representations rather than relying on domain expert for defining them manually.
The course will teach you the theoretical foundations of deep neural networks, which will provide you with the understanding necessary for adapting and successfully applying deep learning in your own to implement, parametrize and apply a variety of deep learning (CNNs) as well as recurrent neural networks (RNNs) and transformers for image, text, and time series analysis. You will further become familiar with advanced data science tools and in using computational resources to train and apply deep learning models.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

- Presentations
- Assignments incldung code stubs
- Jupyter cloud services (personal computer required)
- All material will be shared via Moodle, accessible [HERE]

Technical Requirements

- personal computer required for all seminars and assignments
- ... with access to moodle.tu-ilmenau.de
- ... with access to colab.google.com

Literatur

- Deep Learning: Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press (2016)
- Pattern Recognition and Machine Learning: Christoper M. Bishop, Springer (2006)
- Hands-On Machine Learning with Scikit-Learn and TensorFlow: Aurélien Géron, O'Reilly Media (2017)

Detailangaben zum Abschluss

Das Modul Deep Learning mit der Prüfungsnummer 220488 schließt mit folgenden Leistungen ab:

- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 50% (Prüfungsnummer: 2200822)
- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 50% (Prüfungsnummer: 2200823)

Details zum Abschluss Teilleistung 1:

- multiple coding assignments evaluating methodological and practical competence in the taught concepts - to be individually solved at home with due date and submission via Moodle
- result determined as average across the evaluated solutions to the assignments
- students must register via thoska for this exam, typically within the 3rd and 4th week of the semester

Details zum Abschluss Teilleistung 2:

- one or multiple written tests consisting of multiple-choice and free-form questions evaluating the professional competence in the course's topics
- preferably conducted digitally via Moodle and on the student's device
- final results may be scaled or individual questions may be excluded depending on best performing percentile of students
- students must register via thoska for this exam, typically within the 3rd and 4th week of the semester

Link zum Moodle-Kurs

accessible [HERE]

verwendet in folgenden Studiengängen:

Diplom Elektrotechnik und Informationstechnik 2017
Diplom Elektrotechnik und Informationstechnik 2021
Master Communications and Signal Processing 2021
Master Elektrotechnik und Informationstechnik 2021
Master Fahrzeugtechnik 2014
Master Fahrzeugtechnik 2022
Master Informatik 2013
Master Informatik 2021
Master Ingenieurinformatik 2021
Master Mathematik und Wirtschaftsmathematik 2022
Master Medieningenieurwissenschaften 2023
Master Medientechnologie 2017
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016
Master Technische Physik 2023
Master Wirtschaftsinformatik 2021

Modul: Hybrid Systems

Modulabschluss: Prüfungsleistung schriftlich 120 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Wintersemester

Modulnummer: 200756 Prüfungsnummer:2200855

Modulverantwortlich: Dr. Aouss Gabash

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):116 SWS:3.0

Fakultät für Informatik und Automatisierung Fachgebiet:2211

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	1	0																					

Lernergebnisse / Kompetenzen

By the end of the course, the students are able to classify and evaluate the elementary properties of common signals and hybrid dynamic systems. They areable to derive hybrid dynamic system models for engineering processes and master the use of tools for their simulation. They have basic knowledge in the analysis, synthesis, and stability of hybrid control-loop structures in the time domain.

Vorkenntnisse

Student should have a background in control, systems, or automation engineering.

Inhalt

. Introduction to hybrid systems
. Modelling of hybrid systems
. Numerical algorithms and simulation tools
. Analysis and synthesis of hybrid systems
. Control of hybrid systems
. Stability analysis of hybrid systems

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Blackboard, slides, projector presentations, handouts, online

Literatur

. Reinisch, K. (1974). Kybernetische Grundlagen und Beschreibung kontinuierlicher Systeme. Berlin: VEB Verlag Technik.
. Reinisch, K. (1996). Analyse und Synthese kontinuierlicher Steuerungssysteme und Regelungssysteme. Berlin: VEB Verlag Technik.
. Bequette, B. W. (1998). Process Dynamics Modeling, Analysis, & Simulation. Prentice Hall.
. van der Schaft, A., & Schumacher, H. (2000). An Introduction to Hybrid Dynamical Systems. Springer-Verlag London.
. Lunze, J. (2009). Handbook of Hybrid Systems Control: Theory, Tools, Applications. Cambridge University Press.
. Gabash, A. (2020) Hybrid Systems: Illustrations in MATLAB Live Editor. Textbook, TU Ilmenau.

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle2.tu-ilmenau.de/course/view.php?id=3058

verwendet in folgenden Studiengängen:

Master Elektrotechnik und Informationstechnik 2014 Vertiefung AST
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Medical Visualization

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache:Englisch | Pflichtkennz.:Wahlmodul | Turnus:Wintersemester

Modulnummer: 201199 | Prüfungsnummer:220498

Modulverantwortlich: Prof. Dr. Sylvia Saalfeld

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):105 | SWS:4.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2257

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

. The students are able to understand various visualization techniques and explain them using the example of 2D, 3D, and 4D medical data. As a result of the competencies acquired in the lecture after the second part the students are able to solve exercises and explain them to the other participants.
. The students are capable of implementing visualization techniques, i.e., applying the techniques presented in the course to medical data.
. The students are able to evaluate visualization techniques and thus assess which visualization technique is best suitable for which application scenario.
. The students possess the necessary prerequisite knowledge to develop their own novel visualization techniques.

Vorkenntnisse

Fundamentals in Computer Graphics; Fundamentals Algorithms and Data Structures.

Inhalt

This lecture is centered on the visualization of medical volume data, including Computed Tomography, Magnetic Resonance Imaging, and Nuclear Medicine. It explores various techniques for medical visualization, such as surface and volume rendering, along with interactive methods for adjusting these visualizations using appropriate transfer functions. Advanced topics covered in this lecture include vessel visualization, virtual endoscopy (animated visualizations from viewpoints within the human body, simulating procedures like colonoscopy), and multimodal medical visualization. Furthermore, the lecture delves into subjects related to higher-dimensional data, particularly focusing on simulated and measured blood flow. While a strong interest in medical applications is crucial, prior medical knowledge is not mandatory.
In preparation for the seminar, participants will be given task sheets to complete. During the seminar, the participants have to explain and discuss their solutions in turn with the other participants.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Presentations, Handout, Moodle

Literatur

A list of references with scientific papers will be provided at the end of each lecture

Detailangaben zum Abschluss

Das Modul Medical Visualization mit der Prüfungsnummer 220498 schließt mit folgenden Leistungen ab:

- mündliche Prüfungsleistung über 20 Minuten mit einer Wichtung von 100% (Prüfungsnummer: 2200877)
- alternative semesterbegleitende Studienleistung mit einer Wichtung von 0% (Prüfungsnummer: 2200878)

Details zum Abschluss Teilleistung 2:
2/3 of the set seminar tasks must be solved and, if necessary, explained to the other participants upon request.

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/enrol/index.php?id=864

verwendet in folgenden Studiengängen:

Master Biomedizinische Technik 2021
Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021

Modul: Model-Driven Software-Engineering

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache:Deutsch | Pflichtkennz.:Wahlmodul | Turnus:Wintersemester

Modulnummer: 201200 | Prüfungsnummer:220499

Modulverantwortlich: Dr. Ralph Maschotta

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):116 | SWS:3.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2236

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	1	0																					

Lernergebnisse / Kompetenzen

- Students know the standards and specifications of model-driven software engineering (MDA, MOF, Ecore, UML, Model to Model and Model to Text Transformation (QVT, MofM2T, Xtext))
- Students have acquired skills to create their own domain-specific languages (DSL)
- They can model the structure and behavior of arbitrary domains in a DSL
- In addition, they can develop their own graphical and text-based editors for DSL's
- The students can create generators for generating text (source code) based on models of their own DSL
- The students can apply all the knowledge and skills they have learned in practical applications

Vorkenntnisse

Object-oriented programming, basic knowledge of modeling with UML (e.g. a software engineering lecture)

Inhalt

The purpose of this course is to introduce students to model-driven software engineering practices where models (e.g., software components, activity diagrams, state- or flow charts, etc.) are not used as documentation and reasoning artifacts solely but are first-class products from which other modeling, simulation artifacts or executable source code can be produced.
Students will first learn about appropriate methodologies and suitable tooling support for model-driven software engineering. Then, they will develop their own domain-specific Language in small groups (up to 2 students) and implement a dedicated development environment. Finally, they create a model-to-text generator to generate executable source code from models of their own DSL.
Therefore, the course is a combination of lectures in which the fundamentals of model-driven software engineering are taught (e.g., the definition of the abstract syntax, model notations, and the semantics of DSLs) and practical exercises (e.g. using simple microcontrollers) in which the learned methods of model-driven software engineering are used in practical applications.
Table of Content
Lecture:
· Introduction
· Fundamentals
· Meta-Metamodel (MOF/ ECore)
· Metamodel ((UML-) Structural Modeling)
· Model queries (OCL/AQL)
· Behavioral Modeling (State-Chart, Activities)
· Concrete Syntax
· Model Transformation (M2Text/ QVT)
· Model Persistence (XMI/ Xtext)
Lab:
· Fundamentals of Software Development for Embedded Systems (e.g. Arduino IDE)
· Metamodel
· Viewpoint Specification
· Tools
· Properties and Validation· Model to Text Generation

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Moodle, beamer, PC pool, HW setups (e.g.: Arduino or SSE railroad lab

Literatur

Model-Driven Engineering specifications

- The Object Management Group (OMG) Specifications Catalog;

URL: Object Management Group: The Specifications Catalog. [online] https://www.omg.org/spec

- Meta Object Facility (MOF)

Object Management Group: Meta Object Facility (MOF) Core. 2015, [online] http://www.omg.org/spec/MOF/2.5/

- Model Driven Architecture (MDA)

Object Management Group: MDA - The Architecture Of Choice For A Changing World. [online] http://www.omg.org/mda/

- Unified Modeling Language (UML)

Object Management Group: Unified Modeling Language (UML), - Version 2.5. 2015, [online] http://www.omg.org/spec/UML/2.5/

- MOF Model to Text Transformation Language (MOFM2T)

Object Management Group: MOF Model to Text Transformation Language (MOFM2T). 2008, [online] http://www.omg.org/spec/MOFM2T

- MOF Query/View/Transformation (QVT)

Object Management Group: MOF Query/View/Transformation (QVT). 2016, [online] http://www.omg.org/spec/QVT

- XML Metadata Interchange (XMI)

Object Management Group: XML Metadata Interchange (XMI). 2015, [online] www.omg.org/spec/XMI/2.5.1/

- Eclipse Modeling Project (EMP)

Eclipse Foundation: Eclipse Modeling Project. [online] http://www.eclipse.org/modeling/

- Eclipse SiriusURL

Eclipse Foundation, Obeo - S.A.S: Sirius - The easiest way to get your own modeling tool. [online] http://www.eclipse.org/sirius/

- Eclipse AcceleoURL

Eclipse Foundation, Obeo - S.A.S: Acceleo - Generate anything from any emf model. [online] http://www.eclipse.org/sirius/

Model-Driven Engineering practice

- Martin Fowler: Domain-Specific Languages. Addison-Wesley, 2010. ISBN 978-0-321-71294-3
- Markus Voelter et al., DSL Engineering - Designing, Implementing and Using Domain-Specific Languages, 2013, http://dslbook.org
- Dave Steinberg, Frank Budinsky, Marcelo Paternostro, Ed Merks: EMF: Eclipse modeling framework, 2nd ed., Addison-Wesley, 2009. ISBN: 978-0-321-33188-5.
- John Hutchinson, Jon Whittle, and Mark Rouncefield (2014). "Model-driven engineering practices in industry: Social, organizational and managerial factors that lead to success or failure". In: Science of Computer Programming 89.Part B. Special issue on Success Stories in Model Driven Engineering, pp. 144 -161. ISSN: 0167-6423
- Gunter Mussbacher et al. (2014). "The Relevance of Model-Driven Engineering Thirty Years from Now". In: Model-Driven Engineering Languages and Systems: 17th International Conference, MODELS 2014, Valencia, Spain, September 28 - October 3, 2014. Proceedings. Ed. by Juergen Dingel et al. Cham: Springer International Publishing, pp. 183-200. ISBN: 978-3-319-11653-2
- Alberto Rodrigues da Silva (2015). "Model-driven engineering: A survey supported by the unified conceptual model". In: Computer Languages, Systems Structures 43.Supplement C, pp. 139 -155. ISSN: 1477-8424
- Don Batory and Maider Azanza (2017). "Teaching model-driven engineering from a relational database perspective". In: Software & Systems Modeling 16.2, pp. 443-467. ISSN: 1619-1374
- Physics of Notations
- D. Harel and B. Rumpe (2004). Meaningful modeling: what's the semantics of "semantics"?, in Computer, vol. 37, no. 10, pp. 64-72
- D. L. Moody (2009). The Physics of Notations: Improving the Usability and Communicability of Visual Notations in Requirements Engineering, in 2009 Fourth International Workshop on Requirements Engineering Visualization, Atlanta, GA, pp. 56-57.
- P. Caire, N. Genon, P. Heymans and D. L. Moody (2013) Visual notation design 2.0: Towards user comprehensible requirements engineering notations," in 2013 21st IEEE International Requirements Engineering Conference (RE), Rio de Janeiro, pp. 115-124.

Detailangaben zum Abschluss

Das Modul Model-Driven Software-Engineering mit der Prüfungsnummer 220499 schließt mit folgenden Leistungen ab:

- schriftliche Prüfungsleistung über 60 Minuten mit einer Wichtung von 60% (Prüfungsnummer: 2200879)
- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 40% (Prüfungsnummer: 2200880)

Details zum Abschluss Teilleistung 2:
Solution of the inter-semester seminar tasks (project)

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=561

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Modul: Quantum Computing for Engineers

Modulabschluss: Prüfungsleistung alternativ | Art der Notengebung: Gestufte Noten

Sprache: Deutsch/Englisch | Pflichtkennz.: Wahlmodul | Turnus: Wintersemester

Modulnummer: 201093 | Prüfungsnummer: 2300835

Modulverantwortlich: Prof. Dr. Jörg Schumacher

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 105 | SWS: 4.0

Fakultät für Maschinenbau | Fachgebiet: 2347

SWS nach Fachsemester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

Die Studierenden kennen die Grundzüge des Quantencomputing und des Quanten-Maschinenlernens. Sie verstehen den grundlegenden Aufbau eines Quantencomputers und elementarer Quantenschaltkreisen sowie die Unterschiede zu einem klassischen Computer. Sie sind mit der Ein- und Ausgabe von (klassischen) Daten in einen Quantencomputer vertraut. Sie wenden grundlegende Prinzipien der Quantenmechanik, wie zum Beispiel die Superposition oder die Verschränkung in Algorithmen an. Sie kennen die Spezifika des quantenmechanischen Messprozesses, um die Ergebnisse der Quantenalgorithmen richtig zu interpretieren. Sie haben einen Überblick über grundlegende Algorithmen, die in einer Vielzahl von Anwendungen des Quantencomputings auftauchen, z.B. in Suchalgorithmen, in Quanten-Fouriertransformationen oder bei der Quantenfehlerkorrektur. Sie kennen Grundzüge des maschinellen Lernens, die im Anschluss auf das Quanten-Maschinenlernen übertragen werden. Sie haben sich einen ersten Überblick über die vielschichtigen Anwendungen des Quantencomputings in den Ingenieurwissenschaften und der Wirtschaft verschafft. In den Übungenhaben sie die praktische Programmierung von kleinen Quantenalgorithmen und die Interpretation der Messergebnisse erlernt. Dazu haben sie Kenntnisse zu den grundlegenden Befehlen und Operationen in der Python-Programmierumgebung Qiskit, einem Programm zur Emulation von Quantenalgorithmen für IBM Quantencomputer erworben. Am Ende der Vorlesung sind die Studierenden mit den grundlegenden Begriffen und Algorithmen des Quantencomputings vertraut und können selbst kleine Programme für einen realen Quantencomputer erstellen.

Vorkenntnisse

- Lineare Algebra (Matrizen, Eigenwerte, Eigenvektoren, Spur, Skalares und äußeres Produkt)
- Lineare Abbildungen
- Komplexe Zahlen

Inhalt

- Einführung, Anwendungen und quantenmechanische Grundlagen
- Einfache Quantenschaltkreise für einzelne und mehrere Qubits
- Fundamentale Quantenalgorithmen (Grover, Quantum Fourier Transformation)
- Quantenfehlerkorrektur
- Hassidim-Harrow-Lloyd Algorithmus zur Lösung linearer Systeme
- Grundlagen des maschinellen Lernens
- Quanten-Maschinenlernen

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

- Tafel und Powerpointfolien
- Webex-Übungen mit Jupyter-Notebook auf dem eigenen Laptop

Literatur

- Nielsen and Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2010)
- Weiteres Onlinematerial auf der Moodle-Seite zum Kurs

Detailangaben zum Abschluss

Belegarbeit zu einer Programmieraufgabe

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Diplom Elektrotechnik und Informationstechnik 2021
Master Elektrotechnik und Informationstechnik 2021
Master Maschinenbau 2017
Master Maschinenbau 2022
Master Research in Computer and Systems Engineering 2021

Modul: Software Architectures

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache:Englisch | Pflichtkennz.:Wahlmodul | Turnus:Wintersemester

Modulnummer: 200129 | Prüfungsnummer:220487

Modulverantwortlich: Dr. Detlef Streitferdt

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):105 | SWS:4.0

Fakultät für Informatik und Automatisierung | Fachgebiet:223

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

Domain competence:

After the lectures students have acquired detailed and general knowledge about software engineering methods and tools. They are able to use this knowledge in the project context and they can assess validity and quality of their deliverables. Students can analyze software development processes and they can tailor the processes according to concrete project features. They understand architectural patterns and styles and they can apply them in the project context.

Methodological competence:

After the exercises students are able to apply the presented methods and estimate the results early in the development cycle. They are able to choose and apply the presented development methods in a given project context.

System competence:

Students understand the overall interferences of the methods and process steps for the development of a software architecture.

Social competence:

Students can develop the architecture documentation of an open source project in the lines of a group exercise / project within the semester. They can correctly assess the implications of the soft factors of software development processes based on their group exercises / projects.

Vorkenntnisse

Object-orientation, UML, OO-Programming

C++ and/or Java

Inhalt

This lecture presents software engineering methods and tools. Development activities are embedded in development processes. The lecture teaches students about software architecture goals, ~patterns, the quality of architectures and how to assess this quality.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Slides, PDF-documents, HTML-pages
(Exceptional: Webex for online lectures and exercises.)

Literatur

General

[Fowl 1999] Martin Fowler, "Refactoring - Improving the Design of Existing Code", Addison Wesley, 1999.
[Gamm 1995] Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design Patterns - Elements of Reusable Object-Oriented Software", Addison Wesley, 1995.
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[McCo 2004] Steve McConnell, "Code Complete 2nd Edition", Microsoft Press, 2004.
[Somm 2007] Ian Sommerville,"Software Engineering", Pearson Studium, 2007.
[Mens 2008] T. Mens and S. Demeyer, Eds., "Software Evolution". Springer-Verlag New York Inc, 2008.

Special Topics ...

Developmentprocesses

[Beck 2000] Kent Beck, "eXtreme Programming eXplained", Addison Wesley, 2000.
[Carr 1993] Marvin J. Carr, Suresh L. Konda, Ira Monarch, F. Carol Ulrich, Clay F. Walker, "Taxonomy-Based Risk Identification", Carnegie Mellon University, Technical Report CMU/SEI-93-TR-6, ESC-TR-93-183, 1993.
[Open 2011] Eclipse Process Framework, "Open Unified Process, OpenUP", content retrieved 2011-10-01, 2011.

Requirements

[Bere 2009] Brian Berenbach, Daniel J. Paulish, Juergen Kazmeier, Arnold Rudorfer, "Software & Systems Requirements Engineering In Practice", Mc Graw Hill, 2009.
[Haya 1990] S. I. Hayakawa, "Language in Thought and Action", Harvest Books, 1990.
[KoSo 1998] Gerald Kotonya, Ian Sommerville, "Requirements Engineering - Processes and Techniques", John Wiley & Sons, 1998.
[Kula 2000] Daryl Kulak, Eamonn Guiney, "Use Cases - Requirements in Context", Addison-Wesley, 2000.
[Lams 2001] Axel van Lamsweerde, "Goal-Oriented Requirements Engineering: A Guided Tour", in Proceedings of the 5th IEEE International Symposium on Requirements Engineering (RE 2001), 27-31 August 2001, Toronto, Canada, 2001.
[Lams 2009] Axel van Lamsweerde, "Requirements Engineering: From System Goals to UML Models to Software Specifications", John Wiley & Sons, 2009.
[McCo 2006] Steve McConnell, "Software Estimation", Microsoft Press, 2006.
[Robe 1999] Suzanne Robertson, James Robertson, "Mastering the Requirements Process", Addison-Wesley, 1999.
[Schu 2000] G. Gordon Schulmeyer, Garth R. Mackenzie, "Verification & Validation of Modern Software-Intensive Systems", Prentice Hall, 2000.
[SoSa 1997] Ian Sommerville, Pete Sawyer, "Requirements Engineering: A Good Practice Guide", John Wiley & Sons, 1997.
[Wieg 1999] Karl E. Wiegers, "Software Requirements", Microsoft Press, 1999.
[With 2007] Stephen Withall, "Software Requirement Patterns", Microsoft Press, 2007.

Architecture, Product Lines

[Brow 2011] Amy Brown, Greg Wilson (ed.) "The Architecture of Open Source Applications", Vol. 1, http://aosabook.org, 2011.
[Brow 2012] Amy Brown, Greg Wilson (ed.) "The Architecture of Open Source Applications", Vol. 2, http://aosabook.org, 2012.
[Clem 2002] Paul Clements, Rick Kazman, Mark Klein, "Evaluating Software Architectures", Addison Wesley, 2002.
[Kang 1990] K. Kang, S. Cohen, J. Hess, W. Novak, and A. Peterson, "Feature-Oriented Domain Analysis (FODA) Feasibility Study", SEI Institute, Carnegie Mellon University, USA, CMU/SEI-90-TR-021, 1990.
[Kazm 2000] Rick Kazman, Mark Klein, Paul Clements, "ATAM: Method for Architecture Evaluation", TECHNICAL REPORT, CMU/SEI-2000-TR-004, ESC-TR-2000-004, 2000.
[Lind 2007] F. J. van der Linden, K. Schmid, and E. Rommes, "Software Product Lines in Action: The Best Industrial Practice in Product Line Engineering". Berlin: Springer, 2007.
[Love 2005] Robert Love, "Linux Kernel Development (2nd Edition)", Novell Press, 2005.
[Pohl 2005] Klaus Pohl, Günter Böckle, Frank van der Linden,"Software Product Line Engineering - Foundations, Principles, and Techniques", Springer, Heidelberg 2005.
[Spin 2009] D. Spinellis and G. Gousios, "Beautiful Architecture: Leading Thinkers Reveal the Hidden Beauty in Software Design". O'Reilly Media, 2009.

Computer Science add-ons

[Bern 2003] William Bernbach, "A Technique for Producing Ideas", McGraw-Hill, 2003.
[Broo 1995] Frederick P. Brooks, Jr., "The Mythical Man Month", Addison-Wesley, 1995.
[Mich 2006] Michael Michalko, "Thinkertoys: A Handbook of Creative-Thinking Techniques", Ten Speed Press,

2006.
[Your 1997] Edward Yourdon, "Death March", Prentice-Hall, 1997.

Detailangaben zum Abschluss

Das Modul Software Architectures mit der Prüfungsnummer 220487 schließt mit folgenden Leistungen ab:

- mpndliche Prüfungsleistung über 30 Minuten mit einer Wichtung von 50% (Prüfungsnummer: 2200819)
- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 50% (Prüfungsnummer: 2200820)

A. In the end we will have a oral exam (50% of your mark).

B. Achievements during the semester (only in winter semester):
SW projects (open source) will be analyzed and presented during this lecture. The

(1) report (>=10 pages as PDF) together with the
(2) presentation (slides as PDF)

for both parts you receive a mark resulting in 50% of your final mark. Join in groups of 5-7 students per project. Presentation will take place in January.

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=698

verwendet in folgenden Studiengängen:

Master Medieningenieurwissenschaften 2023
Master Medientechnologie 2017
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Software Safety

Modulabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache:Deutsch/Englisch | Pflichtkennz.:Wahlmodul | Turnus:ganzjährig

Modulnummer: 200002 | Prüfungsnummer:220423

Modulverantwortlich: Prof. Dr. Patrick Mäder

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):105 | SWS:4.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2252

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

Fachkompetenzen hauptsächlich erlangt in Vorlesungen und geprüft durch die abschließende mPl:

- Die Studierenden kennen die Konzepte und Terminologie abhängiger und sicherheitskritischer Systeme (dependability und safety).

- Die Studierenden verfügen über Kentnisse wesentlicher Entwicklungsstandards sicherheitskritischer Systeme und deren Anforderungen an den Entwicklungsprozess von Systemen.

- Die Studierenden wissen, welche zusätzlichen Maßnahmen in allen wesentlichen Phasen eines Software- und Systementwicklungsprozesses im Kontext sicherheitskritischer Entwicklungen, je nach Kritikalität der Anwendung, ergriffen werden sollten und wie diese umzusetzen sind.

- Die Studierenden verfügen über Kenntnis zur qualifizierten Auswahl von Programmiersprachen, Werkzeugen, Code Analyse Techniken für sicherheitskritische Systeme.

Methodenkompetenzen haupsächlich erlangt in den Seminaren und geprüft durch die begleitende aPl (Assignements):

- Die Studirenden sind in der Lage Spezifikationen für sicherheitskritische Systeme zu erstellen.

- Die Studierenden sind in der Lage Sicherheitsanalysen und Safety Cases zu erstellen.
- Die Studierenden sind in der Lage Architekturen und Entwürfe für sicherheitskritische Systeme zu erstellen.
- Die Studierenden sind in der Lage ausgewählte Programmiersprachen für sicherheitskritische Systeme anzuwenden.

Sozialkompetenzen erlangt in Seminaren und Vorlesungen:

- Die Studierenden sind in den Seminaren fähig, die in der Vorlesung gelehrten Methodiken in Gruppenarbeit anzuwenden (z.B. gemeinsam eine FMEA durchzuführen), Lösungstrategien zu diskutieren und Lösungen zu entwickeln.

- Studierende können die Risiken und Risikoerwägungen sicherheitskritischer Entwicklungen (z.B. tollerierbares Risiko) und die damit verbundene Veranwortung der Entwicklungsbeteiligten zum Beispiel anhand schwerer Unfälle mit ihren Lehrenden diskutieren. Sie kennen moralische Erwägungen und länderspezifische Ansätze zum Umgang mit Restrisiko.

Vorkenntnisse

- Grundkenntnisse in Softwaretechnik (Software Engineering) vorteilhaft

Inhalt

Sicherheitskritische Systeme sind solche, deren Versagen oder unzureichende Funktionalität katastrophale Folgen für Menschen, die Umwelt und die Wirtschaft haben kann. Diese Systeme werden kontinuierlich

komplexer in ihren Funktionalitäten, aber auch in ihren Interaktionen mit der Umgebung. Die Veranstaltung widmet sich dem Thema Softwareentwicklung für sicherheitskritische Systeme und stellt Techniken von den eingehenden Sicherheitsanalysen, über Spezifikation und Entwicklung bis zur Verifikation vor. In umfangreichen Übungen werden diese Techniken an Beispielen erlernt und unterstützende Applikationen vorgestellt. Schwerpunkte:

- System Safety
- Safety Standards und Safety Case
- Requirements Engineering und Modellierung*
- Requirements Management, Verifikation und Validierung*
- Architektur und Design Entwicklung, Verifikation und Validierung*
- Safety und Risiko Analyse
- Programmiersprachen, Programmierung, Metriken*
- Testen, Verifikation und Validierung auf Code-Ebene*
- Qualitätssicherung und -management*

*) im Kontext sicherheitskritischer Software- und Systementwicklungen

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

- Vorlesungs- und Seminarfolien als PDF
- aufgezeichnete Screencasts in Deutsch via Moodle and OpenCast
- Tutorials, White-Paper und wissenschaftliche Beiträge verlinkt aus Folien und Moodle
- Entwicklungswerkzeuge
- Auszüge aus Entwicklungsprojekten
- Moodle quizzes als Übergang zur nächsten Vorlesung
- Aufgaben und Aufgabenblätter via Moodle

- Alle Materialien werden via Moodle bereitgestellt. Der folgenden Link zeigt auf den jeweils aktuellen Kurs: [HERE].

Literatur

- C. Hobbs: Embedded Software Development for Safety-critical Systems. CRC Press (2019)
- K. E. Wiegers and J. Beatty: Software Requirements. Mircosoft Press (2013)
- C. Carlson: Effective FMEAs: Achieving safe, reliable, and economical products and processes using failure mode and effects analysis. John Wiley & Sons (2012)
- B. P. Douglass: Real-Time Design Patterns: Robust Scalable Architecture for Real-Time Systems. Addison Wesley (2002)
- E. Hull and K. Jackson and J. Dick: Requirements engineering. Springer (2011)
- Van Lamsweerde: Requirements engineering: from system goals to UML models to software specifications. Wiley Publishing (2009)
- J. Barnes: Safe and secure software: An invitation to Ada 2012. AdaCore (2013)
- J. W. Vincoli: Basic guide to system safety. John Wiley & Sons (2006)
- J.-L. Boulanger: Static analysis of software: The abstract interpretation. John Wiley & Sons (2013)
- J. Schäuffele and T. Zurawka: Automotive software engineering-principles, processes, methods and tools. SAE International (2005)

Detailangaben zum Abschluss

Das Modul Software Safety mit der Prüfungsnummer 220423 schließt mit folgenden Leistungen ab:

- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 50% (Prüfungsnummer: 2200628)
- alternative semesterbegleitende Prüfungsleistung mit einer Wichtung von 50% (Prüfungsnummer: 2200629)

Details zum Abschluss Teilleistung 1:

- multiple assignments evaluating methodological and practical competence in the taught concepts - to be individually solved at home with due date and submission via Moodle
- result determined as average across the evaluated solutions to the assignments
- students must register via Thoska for this exam, typically within the 3rd and 4th week of the semester

Details zum Abschluss Teilleistung 2:

- one or multiple written tests consisting of multiple-choice and free-form questions evaluating the professional competence in the course's topics
- preferably conducted digitally via Moodle and on the student's device
- final results may be scaled or individual questions may be excluded depending on best performing percentile of students

- students must register via Thoska for this exam, typically within the 3rd and 4th week of the semester

Link zum Moodle-Kurs

Kurs: [HERE]

verwendet in folgenden Studiengängen:

Master Fahrzeugtechnik 2014
Master Fahrzeugtechnik 2022
Master Informatik 2013
Master Informatik 2021
Master Ingenieurinformatik 2014
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016
Master Wirtschaftsinformatik 2021

Modul: Systems Optimization

Modulabschluss: Prüfungsleistung schriftlich 90 min Art der Notengebung: Gestufte Noten

Sprache:Englisch Pflichtkennz.:Wahlmodul Turnus:Wintersemester

Modulnummer: 200008 Prüfungsnummer:2200638

Modulverantwortlich: Prof. Dr. Pu Li

Leistungspunkte: 5 Workload (h):150 Anteil Selbststudium (h):105 SWS:4.0

Fakultät für Informatik und Automatisierung Fachgebiet:2212

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							2	2	0																					

Lernergebnisse / Kompetenzen

The students know and can explain

- fundamentals, problem formulation, and classification of optimization methods
- methods and tools for optimization
- different problem formulations and mathematical derivation of optimization methods
- applications in industrial processes

The students have learned the theory, models, methods, and algorithms of the corresponding subjects in the lectures. In the exercises, they had been activated to solve example tasks.

Vorkenntnisse

Fundamentals of Mathematics and Control Engineering

Inhalt

Linear Optimization:
Theory of linear programming, degree of freedom, feasible region, graphical description/solution, Simplex method, mixing problem, optimal production planning

Nonlinear Optimization:
Convexity analysis, problems without uand with constraints, optimality condition, the gradient-, Newton-, Quasi-Newton-methods, KKT conditions, sequential quadratic programming (SQP) methods, active-set method, approximation of the Hessian matrix, application in optimal design of industrial processes.

Mixed-Integer Optimization :
Mixed-Integer Linear Programming (MILP), Branch-and-Bound method, optimization software GAMS, application in optimal design of industrial processes.
Dynamic Optimization:
Discretization in time, Euler method, orthogonal collocation, solution of the problem with SQP

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Video on Demand, Moodle-Kurs, Webex-Veranstaltungen, Folien, Skripte

Literatur

U. Hoffmann, H. Hofmann: Einführung in die Optimierung, Verlag Chemie, Weinheim, 1982
T. F. Edgar, D. M. Himmelblau: Optimization of Chemical Processes, McGraw-Hill, New York, 1989
Teo, K. L., Goh, C. J., Wong, K. H: A Unified Computational Approach to Optimal Control Problems. John Wiley & Sons, New York, 1991
C. A. Floudas: Nonlinear and Mixed-Integer Optimization, Oxford University Press, 1995
L. T. Biegler, I. E. Grossmann, A. W. Westerberg: Systematic Methods of Chemical Process Design. Prentice Hall, New Jersey, 1997
M. Papageorgiou: Optimierung, Oldenbourg Verlag, München, 2006

J. Nocedal, S. J. Wright: Numerical Optimization, Springer-Verlag, 1999

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Communications and Signal Processing 2021
Master Research in Computer and Systems Engineering 2016
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016
Master Wirtschaftsingenieurwesen 2021 Vertiefung AT

Modul: Verifikation

Modulabschluss: Prüfungsleistung mündlich 20 min | Art der Notengebung: Gestufte Noten

Sprache: Deutsch/Englisch | Pflichtkennz.: Wahlmodul | Turnus: Wintersemester

Modulnummer: 200048 | Prüfungsnummer: 2200693

Modulverantwortlich: Prof. Dr. Dietrich Kuske

Leistungspunkte: 5 | Workload (h): 150 | Anteil Selbststudium (h): 116 | SWS: 3.0

Fakultät für Informatik und Automatisierung | Fachgebiet: 2241

SWS nach Fachsemester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							3	0	0																					

Lernergebnisse / Kompetenzen

Die Studenten kennen die Systemmodelle endliche Kripkestruktur, Kellersystem, (vergeßliches) Kanalsystem und wohlstrukturiertes Transitionssystem. Sie kennen die grundlegenden Verifikationsprobleme Erreichbarkeit, wiederholte Erreichbarkeit und das Auswertungsproblem temporaler Logiken. Sie sind vertraut mit den algorithmischen Möglichkeiten und Beschränkungen der Behandlung dieser Probleme sowie die Ausdrucksstärke temporaler Logiken. Sie können ähnliche temporale Logiken bzgl. dieser Kriterien bewerten und die Methoden auf ähnliche Systemmodelle adaptieren.
Sozialkompetenz: Die Studierenden können kritische Fragen zum behandelten Stoff, Probleme bei der Erarbeitung des Wissens bzw. bei der Lösung der Aufgaben klar formulieren und in Diskussionen mit Kommilitonen und Lehrenden vertreten.

The students know the system model of a finite Kripke structure, a pushdown system, a (lossy) channel systen and a well-structures transition system. They know the basic verification problems reachability, recurrent reachability and the model checking problem for termporal logics. They are familiar with the algorithmic possibilities and limitations in handling these problems as well as with the expressive power of temporal logics. They can evaluate temporal logics wrt. these criteria and adapt the methods to similar system models.

The students can clearly formulate critical questions regarding the topics covered, regarding problems wrt. understanding the material and regarding the solutions of exercise questions. They can clearly advance their view in discussion with both, other students and teaching staff.

Vorkenntnisse

endliche Automaten: NFAs, DFAs, Konstruktionen hierzu (vgl. z. B. Modul "Automaten und Formale Sprachen")

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finite automata (NFAs, DFAs), pushdown automata, related constructions (cf. e.g. module "automata and formal languages")

Inhalt

Erreichbarkeitsproblem, wiederholtes Erreichbarkeitsproblem, Auswertungsproblem temporaler Logiken
endliche Kripkestrukturen, Kellersysteme, (vergeßliche) Mehrkanalsysteme, wohlstrukturierte Transitionssysteme

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reachability, recurrent reachability, model checking temporal logics
finite Kripke structures, (lossy) channel systems, well-structured transition systems

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Tafel, Übungsblätter

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board, exercise sheets

Literatur

Clark, Grumberg, Peled: Model Checking, MIT Press 2000
Gabbay, Hodkinson, Reynolds: Temporal Logic, Ox. Univ. Press 1994
Emerson: Temporal und Modal Logic. In: J. van Leeuwen (Ed.): Handbook of Theoretical Computer Science, Chapter 16, Amsterdam 1990

Detailangaben zum Abschluss

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=38

verwendet in folgenden Studiengängen:

Master Informatik 2013
Master Informatik 2021
Master Ingenieurinformatik 2021
Master Research in Computer and Systems Engineering 2021
Master Research in Computer & Systems Engineering 2016

Modul: Research Seminar

Modulabschluss: Prüfungsleistung alternativ | Art der Notengebung: Gestufte Noten

Sprache:Deutsch/Englisch | Pflichtkennz.:Pflichtmodul | Turnus:ganzjährig

Modulnummer: 200742 | Prüfungsnummer:2200849

Modulverantwortlich: Silke Eberhardt-Schmidt

Leistungspunkte: 5 | Workload (h):150 | Anteil Selbststudium (h):150 | SWS:0.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2200

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
				150 h																										

Lernergebnisse / Kompetenzen

After the research seminar students have deepened the knowledge in dealing with scientific texts in a receptive and descriptive way. They are able to perform an independent analysis of a method based on one or more pieces of scientific literature up to one's own understanding. Students are able to present the results to other students and the organizer, and can respond to questions and discussions on a scientific level. They can summarize their results in a writen report. The seminar has also trained the communication skills of the students in a subject-specific context.

Vorkenntnisse

Inhalt

The topic will be provided by a supervisor from a research group at the Faculty. The students learn to work with scientific literature and to present results in accordance with scientific standards. The students apply their knowledge from the research on a practical problem under supervision of a member of the research group. The documentation of their work contains a written report and a presentation of their results. The presentation is followed by a scientific discussion with the audience.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Literatur

Literature may be provided with the issue of the topic or will be researched independently.

Detailangaben zum Abschluss

A report document and a presentation talk(presentation: 20 minutes, discussion: 10 minutes) about the results (self-study: 128 h, on-campus program: 22 h) are required. Depending on thetopic there may be additional requirements (for example softwareimplementation, experimental results, demonstration, etc.)

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Modul: Group Studies

Modulabschluss: Prüfungsleistung alternativ | Art der Notengebung: Gestufte Noten

Sprache:Deutsch/Englisch | Pflichtkennz.:Pflichtmodul | Turnus:ganzjährig

Modulnummer: 200740 | Prüfungsnummer:2200847

Modulverantwortlich: Silke Eberhardt-Schmidt

Leistungspunkte: 10 | Workload (h):300 | Anteil Selbststudium (h):300 | SWS:0.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2200

SWS nach Fachsemester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							300 h																							

Lernergebnisse / Kompetenzen

After the group studies project the students have learn to solve a research problem. They are able to develop an approach in a team of peers. A team consists of 2-4 members. They have deepened the knowledge in dealing with scientific texts in a receptive and descriptive way and have improved their capabilities of working together in a team. The students have developed organizing and co-working skills of each member as well as their joint processing of a topic.

Vorkenntnisse

Inhalt

Individual research topics will be provided by RCSE professors. The students apply their knowledge from the research on a practical problem under supervision of a member of the research group. The documentation of their work contains a written report and a presentation of their results. The presentation is followed by a scientific discussion with the audience.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Literatur

Depending on the project, literature will be provided with the issue of the topic or will be researched independently.

Detailangaben zum Abschluss

The performance in Group Studies must reflect about *300* working hours per student (10CP x 30 hours).

Results submission:
For completing Group studies students must prepare a written report and a presentation.
Report:
One report must be prepared for each project (per group). Students must use the IEEE template for their report.
Presentation:
Students must present their final results in the Research Group meeting of their supervisor. Presentation should take 20-30 min per team + 10 min discussion.
The final grade includes 60% grade from the documentation (report) and 40% from your presentation.

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Modul: Research Project

Modulabschluss: Prüfungsleistung alternativ | Art der Notengebung: Gestufte Noten

Sprache:Deutsch/Englisch | Pflichtkennz.:Pflichtmodul | Turnus:ganzjährig

Modulnummer: 200741 | Prüfungsnummer:2200848

Modulverantwortlich: Silke Eberhardt-Schmidt

Leistungspunkte: 15 | Workload (h):450 | Anteil Selbststudium (h):450 | SWS:0.0

Fakultät für Informatik und Automatisierung | Fachgebiet:2200

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							450 h																							

Lernergebnisse / Kompetenzen

The students are able to work on current research topicsunder supervision. They should be able to analyze open problems, to describethe current state of the art and to develop as well as implement approaches fornovel solutions.

Vorkenntnisse

Inhalt

Research work will be supervised at a research group of the Faculty. The students learn to work with scientific literature and to present results in accordance with scientific standards. The students apply their knowledge from the research on a complex practical problem under supervision of a member of the research group. The documentation of their work contains a written report and a presentation of their results. The presentation is followed by a scientific discussion with the professional audience.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Literatur

Literature may be provided with the issue of the topic or will be researched independently.

Detailangaben zum Abschluss

A report document and a presentation talk (presentation: 20 minutes, discussion: 10 minutes) about the results (self-study: 405 h, on-campus program: 45 h). Depending on the topic, there may be additional requirements (for example software implementation, experimental results, demonstration, ...).

Link zum Moodle-Kurs

https://moodle.tu-ilmenau.de/course/view.php?id=187

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

TECHNISCHE UNIVERSITÄT ILMENAU

Internship

Fachabschluss: Studienleistung alternativ | Art der Notengebung: Testat / Generierte

Sprache:Englisch | Pflichtkennz.:Wahlmodul | Turnus:ganzjährig

Fachnummer: 201087 | Prüfungsnummer:2200858

Fachverantwortlich: Silke Eberhardt-Schmidt

Leistungspunkte: 15 | Workload (h):450 | Anteil Selbststudium (h):405 | SWS:4.0

Fakultät für Informatik und Automatisierung | Fachgebiet:22

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
							10 weeks (optional)																							

Lernergebnisse / Kompetenzen

The students have gained skills and motivations to a particular field of application in the IT industry by solving specific tasks. They are familiar with general aspects of industrial environment, such as teamwork, working to a deadline, economic efficiency, quality management or data protection. They have elaborated soft skills. The students are able to familiarize themselves with a complex problem within an operational environment. They have learned about the organisation of the company, social structures, co-working, aspects of safety and security as well as economic facets. The internship has developed the ability of the students to apply and deepen their knowledge from their studies in an industrial field. Especially the co-working process with colleagues on big work-sharing projects and the communication between the students and their colleagues as well as their bosses as important experiences have been trained.

In the specialist internship, students have gained an insight into the work of industrial companies or scientific research institutions in Germany or abroad that work in the field of computer science.

Vorkenntnisse

Inhalt

Practical activities in which scientific methods are put into practice within an industrial or practical context of IT companies or organizations with the aim to conceptualize, implement, evaluate, utilize and maintain complex computer systems. It contains a largely independent, scientific activity and the topic must contain a specific problem formulation. It must not contain only simple tasks, for the fulfillment of which the procedure is known. The documentation of their internship contains a written report and a presentation of their work. The presentation is followed by a scientific discussion with the audience.

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Literatur

The supervisor will announce subject-specific literature. Further literature has to be researched independently by the student.

Detailangaben zum Abschluss

- Activity Report
- colloquium with discussion

Details can be found in the PStO-BB

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

TECHNISCHE UNIVERSITÄT ILMENAU

Master´s Thesis with Colloquium

Fachabschluss: mehrere Teilleistungen | Art der Notengebung: Generierte Noten

Sprache: | Pflichtkennz.:Pflichtmodul | Turnus:unbekannt

Fachnummer: 201088 | Prüfungsnummer:99000

Fachverantwortlich: Silke Eberhardt-Schmidt

Leistungspunkte: 30 | Workload (h):900 | Anteil Selbststudium (h):900 | SWS:0.0

Fakultät für Informatik und Automatisierung | Fachgebiet:22

SWS nach Fach-semester	1.FS			2.FS			3.FS			4.FS			5.FS			6.FS			7.FS			8.FS			9.FS			10.FS		
	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P	V	S	P
										900 h																				

Lernergebnisse / Kompetenzen

Vorkenntnisse

Inhalt

Medienformen und technische Anforderungen bei Lehr- und Abschlussleistungen in elektronischer Form

Literatur

Detailangaben zum Abschluss

Link zum Moodle-Kurs

verwendet in folgenden Studiengängen:

Master Research in Computer and Systems Engineering 2021

Glossar und Abkürzungsverzeichnis:

LP	Leistungspunkte
SWS	Semesterwochenstunden
FS	Fachsemester
V S P	Angabe verteilt auf Vorlesungen, Seminare, Praktika
N.N.	Nomen nominandum, Platzhalter für eine noch unbekannte Person (wikipedia)
Objekttypen lt. Inhaltsverzeichnis	K=Kompetenzfeld; M=Modul; P,L,U= Fach (Prüfung,Lehrveranstaltung,Unit)