TECHNISCHE UNIVERSITÄT CHEMNITZ

Faculty of Computer Science

Code	565030
Name	Real-Time Systems
Professor	Prof. Dr.-Ing. habil. Matthias Werner
Language	English
Language of teaching materials	English & German
Contents	*Programs:* Bachelor Computer Science and Applied Computer Science; Bachelor Biomedical Technology; Master Computer Science and Applied Computer Science; Master Automotive Software Engineering; Master Embedded Systems; Master Web Engineering. *Overview:* This course introduces concepts and design methods for real-time systems. Topics include real-time requirements, scheduling, resource conflicts, real-time communication, and soft real time. *Objects:* Theory and practice of calculation systems used to solve time-critical problems: Time management, standards, clocks; Scheduling procedures of periodic and aperiodic requirements; Resource management (priority inversion, ~ inheritance, ~ ceiling); Management of mass storage; Caching and main memory management; Error tolerance in real-time systems; Appropriate communication mechanisms and protocols; Processor architectures for real-time systems; Real-time operating systems. Qualification objectives: Knowledge of the general principles of real-time systems.
Requirements	Basic knowledge on computer architecture/organization; Programming basics; Operating system concepts; Basic knowledge on mathematics.
Level	Bachelor*
Semester	Summer
ECTS	5

Code	553150
Name	XML
Professor	Prof. Dr.-Ing. Martin Gaedke
Language	English
Language of teaching materials	English
Contents	*Overview:* Extensible Markup Language (XML) is the basis of a number of developments in the World Wide Web. XML plays a central role in data transport and integration as well as in many modern software applications. The course offers a basic introduction into XML and its applications in different contexts of distributed systems, distributed software and Web. Various state-of-the-art application scenarios and pragmatic tools are presented. The topics cover: Introduction to Markup languages and XML; Basic approaches, such as DTD, XML schemes, XML editors, XML applications, linking, XPath, XSL/XSLT; Data formats and tools, i.e. SVG, RSS; Semantics Formats and tools, i.e. RDF, OWL, digital rights with Creative Commons; User interface Formats and tools, i.e. XHTML, XForms, MicroFormats; Application logic Formats and tools, i.e. existing XML Web Services for advertising, blogs, collaboration, content analysis, E-commerce, maps, social bookmarking, search, sight/sound/motion, storage, tagging. *Objects:* Basic understanding of Markup languages; Familiarity with XML applications and tools; Ability to make use of XML applications and XML Web services in the creation of sophisticated distributed applications; Basic Semantic Web knowledge; Ability to use metadata technologies, in particular for realizing Semantic Web resources.
Requirements	Computer Networks
Level	Bachelor*
Semester	Winter
ECTS	5

Code	553030
Name	Design of Distributed Systems
Professor	Prof. Dr.-Ing. Martin Gaedke
Language	English
Language of teaching materials	English
Contents	*Overview:* Computer and communication networks, as well as the web, have developed into an efficient work tool, a universal information source and a nearly ubiquitous communication medium in the past two decades. They are an indispensable part of our everyday lives. They are formed by the union of different systems that communicate with each other over networks, thus enabling information sharing among themselves. Data exchange and forwarding are performed by applying appropriate approaches and algorithms, which are called protocols. This module deepens the knowledge about the basic approaches, concepts and principles of such distributed systems. This includes Internet and World Wide Web technologies as well as an introduction of the development of Web Services and Service-Oriented Architectures (SOA). The module provides insight into different approaches of distributed systems and an in-depth look at the central aspects of the design of distributed systems. *Objects:* Improved knowledge of approaches, methods, principles and tools in the field of distributed systems and web engineering; Ability to design, implement and manage complex distributed applications.
Requirements	Computer Networks
Level	Bachelor*
Semester	Winter
ECTS	5

Code	553130
Name	Security Distributed Software
Professor	Prof. Dr.-Ing. Martin Gaedke
Language	English
Language of teaching materials	English
Contents	*Overview:* The course focuses on problems in security of computer networks and connected applications. We will show possibilities of attack and weaknesses and discuss safety concepts. The course includes: Introduction to identity, dangers, risks, healing and security; Introduction to methods and approaches of cryptography; Identity & Access Management, such as Provisioning, Policies, Single Sign On (SSO), Directory Services, RBAC, 802.1X; Approaches, services, and tools for computer network security, e.g. IP-Sec, Kerberos, Certificates, LDAP, RADIUS, Firewalls, IDS, Sniffer, Scanner; Application-oriented security, e.g. Data exchange, mail and web applications; Management and security aspects of wireless local area networks; Federation of rights, e.g. Shibboleth, WS-Federation, Liberty Alliance Project; Measures for the systematic planning, execution and monitoring of safety Trends, e.g. Self-management, self-healing. *Objects:* Basic understanding of mechanisms for securing computer systems such as identity and authorization management, secure handling of XML applications and tools. Learn about systematic approaches of security in distributed systems.
Requirements	Computer Networks
Level	Bachelor*
Semester	Summer
ECTS	5

TECHNISCHE UNIVERSITÄT CHEMNITZ

Faculty of Computer Science

Code	573180
Name	Neurocomputing
Professor	Dr. Julien. Vitay
Language	English
Language of teaching materials	English

Contents	*Overview:*
	
	The course will introduce a variety of methods using neural networks to learn to solve useful problems. The first part of the course covers the deep learning area, starting from an introduction to machine learning and old-school neural networks up to current research trends. The second part will introduce other forms of neural network structures (attractor networks, reservoir computing, unsupervised Hebbian learning and spiking networks) which may be used to build complex cognitive architectures.
	The different algorithms presented during the lectures will be studied in more details during the exercises, through implementations in Python (tensorflow, keras).
	
	Focus:
	1. Deep learning
	  1. Linear algorithms (regression, classification)
	  2. Neural Networks (MLP, regularization)
	  3. Deep Learning (CNN, autoencoders, GAN)
	  4. Recurrent neural networks (LSTM, attention)
	2. Neurocomputing
	  1. Attractor networks (Hopfield, neural fields)
	  2. Reservoir computing
	  3. Unsupervised Hebbian learning
	  4. Deep spiking networks
	
	Objectives:
	
	Knowledge of the procedures for machine learning.

Requirements	Modules in Mathematics I to IV Basic knowledge in Python.
Level	Bachelor*
Semester	Winter
ECTS	5

TECHNISCHE UNIVERSITÄT CHEMNITZ

Faculty of Computer Science

Code	573010
Name	Computer Vision
Professor	Jun-Prof. Danny Kowerko
Language	English
Language of teaching materials	English
Contents	*Overview:* The course is an introduction to computer vision, from basic image processing (filters, Fourier transformation) to more advanced algorithms (object recognition, movement, facial features extraction). The module provides an introduction to image comprehension, with particular reference to methods of artificial intelligence. Emphasis is on the understanding of images. Focus: • Overview of image comprehension • Basics of digital image processing • Image preprocessing • Image segmentation • Characteristics of objects • Object recognition • Three-dimensional image interpretation • Motion analysis; Optical flow *Objects:* Knowledge about elementary operations of image processing, methods for object recognition and spatial image interpretation
Requirements	Modules in Mathematics I to IV Basic knowledge in Python.
Level	Bachelor*
Semester	Winter
ECTS	5

TECHNISCHE UNIVERSITÄT CHEMNITZ

Faculty of Computer Science

Code	561030
Name	Multicore Programming
Professor	Prof. Dr. Gudula Rünger
Language	English
Language of teaching materials	English & German
Contents	*Overview:* The lecture comprises an introduction to the architecture of multicore processors, programming models for multicore programming, and the programming with threads. Different languages and library-based approaches for thread-programming are covered. The contents of the lecture include: Overview of multicore processors, multicore thread sets, multicore programming, multi-core programming, Java threads, new language sets, transaction memory. *Objects:* Knowledge of all concepts and recent developments in multicore programming as well as their practical application in software development for multicore architectures.
Requirements	Programming knowledge in C; Basic knowledge of computer architecture.
Level	Bachelor*
Semester	Winter
ECTS	5

Code	555070
Name	Hardware/Software-Codesign I
Professor	Prof. Dr. Wolfram Hardt
Language	English
Language of teaching materials	English & German
Contents	*Overview:* Embedded Systems are digital, software based systems that work within bigger systems and control the behavior of these systems. They are based on a hardware platform and software programs of different complexity. These systems are playing an important role in our daily life. Examples are mobile phones, washing machines, control units (car, plane, ...) and control systems for industrial machines. Focus: • Insight into various design methods and structures for the Embedded Systems • Overview and comparison of target architectures and components for Hardware / software systems • Selected problems of hardware and software synthesis • General partitioning procedures • Hardware / software bi-partitioning The subject can be continued with Hardware/Software Codesign II which is offered in the next semester. *Objects:* Basic understanding of the Hardware/Software Codeign
Requirements	none
Level	Bachelor*
Semester	Winter
ECTS	5

Code	555090
Name	Hardware/Software-Codesign II
Professor	Prof. Dr. Wolfram Hardt
Language	English
Language of teaching materials	English & German
Contents	*Overview:* Embedded Systems are digital, software based systems, that work within bigger systems and control the behavior of these systems. They are based up on a hardware platform and software programs of different complexity. These systems are playing an important role in our daily life. Examples are mobile phones, washing machines, control units (car, plane, ...) and control systems for industrial machines. Based on the lecture of the Hardware/Software Codesign I (System Architectures, Code Generation, Partitioning) this course covers further methodologies and technologies, which are necessary and widely spread for the development of complex embedded systems. Main topics are: Estimation of Design Parameters; Interfaces and Interface Synthesis; Rapid Prototyping and Emulation; Co-Specification and Co-Simulation. The course Hardware/Software Codesign II includes a practical course, where an exemplary HW/SW system has to be implemented. It includes hardware development (VHDL) and low-level software implementation (C). Digilent Nexys 3 boards with a XILINX Spartan 6 FPGA are used as target architectures. *Objects:*
Requirements	Basic knowledge in Hardware/Software-Codesign I
Level	Bachelor*
Semester	Summer
ECTS	5

TECHNISCHE UNIVERSITÄT CHEMNITZ

Faculty of Computer Science

Code	555010
Name	Formal Specification and Verification
Professor	Prof. Dr. Wolfram Hardt
Language	English
Language of teaching materials	English
Contents	*Overview:* Presentation of selected topics from the field of formal specification and verification of distributed embedded systems based on examples from the aerospace (and automotive) industry; Languages for system design and verification, including their mathematical, process-algebraic foundation; Introduction to public domain tools for system design, system simulation, and model checking (e.g. SPIN and UPPAAL). Focus: Theoretical principles of system modeling and simulation; System life cycle and system development processes; Formal Specification Techniques for Embedded Systems - Selected Aerospace Engineering Techniques; Formal verification of functional and non-functional properties of embedded systems; Safety aspects Embedded systems and techniques for their verification. *Objects:* Ability to formal specification, knowledge of verification procedures.
Requirements	Basic knowledge in hardware / software code design.
Level	Bachelor*
Semester	Summer
ECTS	5

P.S.

“Bachelor*” means that current course is also available for master students in certain study programs.