Valid from 2024.HS

Module description: Information Theory and Coding

Module Code	t.BA.IT.INCO.13HS
ECTS Credits	4
Language of Instruction/Examination	German
Organizational Unit	InES
Module Coordinator	Matthias Rosenthal
Legal Framework	The module description is part of the legal basis in addition to the general academic regulations. It is binding. During the first week of the semester a written and communicated supplement can specify the module description in more detail.
Module Characteristic	Type 3a 2 lecture lessons per semester week and class+ 2 lab bi-weekly lessons per semester and half-class
Module Description	This course teaches the basics of digital information processing and coding. Basic digital units, gates and logic are part of it as well as source coding (information, entropy, redundancy) and channel coding methods with error detection and correction.
Module Content	• General principles:- Algorithm Concept, Algorithm by Euclid- Units and basic concepts: Bit, byte, word.- Complement representation (single and two's complement); arithmetic in the number range; Carry / Borrow / Overflow; Sign Extension Digital technology:- Logical functions and gates: INV, AND, OR, NAND, NOR, XOR- Truth table and combinatorial basic circuits: Karnaugh diagrams, half/full adders, subtractors, decoders (e.g. BCD => 7-segment), code conversions, comparator.- Sequential logic: counter, shift register, simple automaton (traffic light) Information theory:- Information theory according to Shannon- Concept of entropy, calculation of entropy Most important methods of source coding:- Basic concepts: Reduced redundancy and irrelevance, prefix-free codes- Huffman, arithmetic coding, run length coding, Lempel-Ziv coding, JPEG, MPEG (for MPEG only overview, approaches); - Overview of the encodings and their fields of application Most important methods of channel coding:- Channel capacity according to Shannon- Hamming distance- Most important methods for error detection (parity, CRC, checksum)- Error-correcting codes (Hamming code)- Block code, convolution code (overview)
Prerequisite Knowledge	

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Learning Objectives (Competences)

Students...	Competencies	Taxonomies
Information theory 1 (source coding):- Understanding the basic concepts of information theory (information content, entropy) according to Shannon and can calculate entropy for simple examples.- Understanding the difference between redundancy and irrelevance reduction in source coding and the basic methods of redundancy reduction. You are familiar with the application of the elementary methods for redundancy reduction using simple examples.	F, M	K2, K3
General principles:- Understanding the basic units in computer science (bit, byte, etc.) and their different meanings or value ranges and being proficient in the use of different number systems as well as the representation of numbers and characters.	M, F	K1, K2
Digital technology:- Understanding the functional logic of digital gates, interpreting schematics and master the realization of simple functions as well as the creation and interpretation of truth tables.- Knowing and understanding simple combinatorial basic circuits, such as simple adder logics (half-adder, full adder, multiplexer).- Knowing and understanding simple sequential logic circuits (counter, graycode, registers, shift registers, simple, finite state machines).	F, M	K2
Information theory 2 (channel coding):- You understand the basics of channel coding for the transmission of binary data. You understand the basic concepts about the use of channel bandwidth according to Nyquist. You know how to calculate the channel capacity according to Shannon.- You understand the most important methods for error detection and error correction.- You can define the term Hamming distance.- You will master the application of the most important error correction methods using simple examples.	F, M	K2, K3

Performance Assessment

End-of-module exam	Assessment	Length (min.)	Weighting	Form
written exam	Grade	90	100	acc. to module agreement

Performance assessment during the semester	Assessment	Length (min.)	Weighting	Form
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Classroom Attendance Requirement

None

Learning material

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Comments	