CORSO DI LAUREA IN INFORMATICA

BACHELOR IN INFORMATIK

Contenuto degli insegnamenti
Inhalt der Lehrveranstaltungen

Analysis   • Sequences and series   • Univariate functions   • Derivatives, differentials and Taylor Theorem   • Riemann integral   • Logarithmic and exponential functions   • Limits of functions and continuity
Artificial Intelligence
Module 1: Foundation of Artificial Intelligence   • Artificial Intelligence and Agents   • Searching for Solutions   • Reasoning with Constraints   • Propositions and inference   • Planning with Certainty   • Multiagent Systems and Games
Module 2: Machine Learning in Practice   • Feature Extraction   • Frequent Pattern Recognition   • Regression Analysis   • Rule-based Classification and Decision Trees   • Bayesian Classifiers sof   • K-Means Clustering
Computational Mathematics (cohorts from 2024- course starting from a.J. 26/27)   • Introduction to computational modeling and principles of finite precision computation   • Numerical methods for solving ordinary differential equations   • Iterative methods for solving nonlinear equations and optimization problems   • Matrix factorization methods: LU, Cholesky, QR, and singular value decomposition   • Applications in data science: regression, data compression, and principal component analysis   • The Google PageRank problem and its applications: power method, shifted power method, and inverse power method

Computational Security (cohorts till 2023)
Module 1: Computational Mathematics • Principles of finite precision computation • Direct methods for solving linear systems • Iterative methods for linear algebra • Singular value decomposition • Rootfinding methods for solving nonlinear equations • Functional approximation
Module 2: Information Security • Basic definitions: CIA, threat, attack, vulnerability, access control • Risk assessment • Basics of cryptography • Network attack and defense • Usability • Security policies
Computer Networks • Introduction to computer networks • ISO OSI reference model • Internet applications and application protocols (HTTP, SMTP, DNS) • Network protocols: TCP/IP, Ethernet • Sockets and RPCs • Failure robustness, security
Computer Programming • Data types and expressions • Basic data structures and generic • Functions and parameter passing • Conditionals and loops • Arrays and collections • Classes and objects • Basic Input/Output • Exception handling • Recursion
Computer Systems Architecture • Computer systems organization: processors, primary memory, secondary memory, input/output and parallel architectures. • Boolean algebra and gates: Boolean algebra, gates, implementation of Boolean functions, circuit equivalence. • Digital circuits: arithmetic circuits, clocks, memory, CPU chips, buses. • Microarchitecture: design of the microarchitecture level, performance optimization. • Instruction sets: data types, instructidata son formats, addressing, instruction types, flow of control. • Introduction to Assembly language

Database Management Systems

- Physical data storage
- Indexing and hashing
- Query processing and optimization
- Transaction processing
- Concurrency control
- Recovery

Data Structure and Algorithms

- Design Principles: Problem reduction via recursion
- Searching and Sorting
- Correctness: Loop invariants, termination
- Complexity: Asymptotic analysis
- Divide and Conquer
- Pointers, dynamic data structures, linked lists
- Abstract data types: stacks, queues, priority queues, maps
- Binary trees, red-black trees
- Graph Search

Discrete Mathematics

- Elements of logic, propositions and quantifiers, methods of mathematical proof
- Numbers and basic number theory
- Set Theory, Russell Paradox and Halting Problem
- Functions, infinite cardinalities and countability
- Relations, orders, equivalence classes
- Graphs and trees

English for Computer Scientists 1

- General overview of grammatical structures at the C1 level;
- Development of receptive skills through the exposure to and analysis of various types of written and spoken discourse typical in Computer Science and development of grammatical and lexical range and accuracy so that communication is fluent and spontaneous;
- Vocabulary acquisition and word-building techniques; lexicogrammar.

English for Computer Scientists 2

- Study skills: focus on developing the specific study skills that are required in this undergraduate programme in Computer Science including critical thinking skills;
- Writing skills: practice of coherent academic discourse to produce subject-specific texts in English at the C1 level, including formal academic emails, reports and summaries;
- Spoken skills: improvement of spoken interaction and production through the practice and production of academically and professionally acceptable presentations and other domain-specific speaking activities.

Formal Languages and Compilers

- Formal language theory
- Regular languages: automata, regular expressions, regular grammars
- Context free languages (stack machines)

- Lexical and syntactic analysis: Lexer specification, top-down and bottom-up parsing
- Semantic analysis: Rules for type checking, symbol table and control flow
- Intermediate code generation

German for Computer Scientists

- Listening skills: comprehension of talks, documentary, reportings, descriptions in different contexts, on different media, about ICT topics
- Writing skills: practice of coherent academic discourse to produce subject-specific texts (for example application letter, report, product review, compliant mail, instructions, essay, abstract, summary, seminar work etc.) about ICT topics;
- Spoken skills: improvement of spoken interaction and production through the practice and production of academically and professionally acceptable presentations and other domain-specific speaking activities;
- Development of receptive skills (reading and listening, both global and detailed) through the exposure to and analysis of various types of authentic written and spoken discourse typical in Computer Science and development of grammatical and lexical range and accuracy so that communication is fluent and spontaneous;
- Language mediation (mediating communication, text and concepts) from English to German and viceversa about area of expertise (ICT);
- Vocabulary acquisition and word-building techniques; lexicogrammar.

Intelligent Agents

Module 1: Knowledge Representation

- Propositional and First-Order Languages
- Individuals and Relations
- Knowledge Representation and Logic
- Knowledge-Based Systems: Description Logics and Ontologies
- Non-classical Logic and Formal Reasoning
- Common-Sense Knowledge

Module 2: Intelligent Agents Project

- AI paradigms: symbolic approaches vs. learning-based approaches
- Overview of main AI techniques: exact and approximate methods, handling imperfect information, use and model of domain knowledge
- Tools and programming techniques for the development of AI systems
- Symbolic approaches: planning and search, constraint solving, description logic and ontologies, multi-agent models
- Learning-based approaches: supervised vs. unsupervised and reinforcement learning, neural networks
- Hands-on programming projects covering the above topics

Interactive Interface Design and Development (cohorts from 2023)

- Fundamentals of interaction design.
- Fundamental of interaction design principles for web apps.
- Fundamental of interaction design patterns for web apps.
- Interaction design prototyping techniques for web apps.
- Interaction design prototyping tools for web apps.
- Fundamentals of web programming, client-side, for web apps

Introduction to Business Administration (cohorts from 2020 to 2022)

- Introduction to management: company overview and business functions, capital configuration, company equilibrium, organizational dynamics
- Accrual Accounting and Financial Statements
- Managerial accounting for decision making (costing and pricing), planning, budgeting and reporting

Introduction to Databases

- Relational data model and relational algebra
- The SQL language
- Using SQL in database applications: API, embedded SQL
- The Entity Relationship model
- Conceptual database design
- Logical database design

Italian for Computer Scientists

- Listening skills: comprehension of talks in different contexts, live, by phone or other media, about ICT topics
- Writing skills: practice of coherent academic discourse to produce subject-specific texts; practice of all communication texts, such as e-mails, web texts;
- Spoken skills: improvement of spoken interaction and production through the practice and production of academically and professionally acceptable presentations and other domain-specific speaking activities;
- Development of receptive skills through the exposure to and analysis of various types of written and spoken discourse typical in ICT and development of grammatical and lexical range and accuracy so that communication is fluent and spontaneous;
- Language mediation (mediating communication, text and concepts) from English to German and viceversa about area of expertise (ICT);
- Vocabulary acquisition and word-building techniques; lexicogrammar.

Linear Algebra

- Background on complex numbers, trigonometry and polynominals
- Vectors and matrices
- Linear Systems
- Vector spaces
- Linear operators
- Spectral analysis

Maker Lab (cohorts from 2020 to 2022)

- Basics of programming for physical computing and interactions with the world using Python 3
- Basics of electronics for physical computing: interruptors, sensors, actuators and hats
- Basics of interaction design and development for physical computing

Mobile and Physical Systems

Module 1: Engineering of Mobile Systems

- Functional and declarative programming
- Design of mobile applications
- Frameworks and platforms for mobile development
- Data and resource management in a mobile context

• Mobile device sensors • Internet of Things
Module 2: Physical Computing Project (cohorts from 2020 to 2022) / Prototyping Physical Interactive Experiences (cohorts from 2023 – starting from a.j. 25/26) • Introduction to interaction design for physical computing • Physical computing hardware for interactive solutions • Physical computing software for interactive solutions • Ideation and conceptualisation of physical computing solutions • Development of physical computing solutions • Evaluation of physical computing solutions
Network Security (cohorts from 2024- starting from a.j. 26/27)
Module 1: Computer Networks • Introduction to computer networks • ISO OSI reference model • Internet applications and application protocols (HTTP, SMTP, DNS) • Network protocols: TCP/IP, Ethernet • Sockets and RPCs • Failure robustness, security
Module 2: Information Security • Basic definitions: CIA, threat, attack, vulnerability, access control • Risk assessment • Basics of cryptography • Network attack and defense • Usability • Security policies
Operating Systems • Programming in C • Scheduling and concurrency • Processes and synchronization • File systems and memory management • Storage management • Security and protection
Probability Theory and Statistics • Basic concepts: probability spaces, conditional probability, Bayes' Theorem, independent events • Random variables: distribution, density, expectation, variance, covariance, law of large numbers • Special distributions: Bernoulli, Binomial, Poisson, Exponential, Normal, Chi-Square, t-Distribution • Sampling: sums of random variables, central limit theorem, sample variance • Parameter Estimation: maximum likelihood estimates, interval estimates, confidence intervals • Hypothesis testing: significance levels, test statistics, p-values
Programming Project • Objects and Classes: Interfaces, Inheritance and Polymorphism

- Abstract data types (set, list, map, queue)
- Dynamic Data structures (linked list, hashmap)
- Recursion
- Serialisation and streams
- Mutability, pure functions and lambda expressions
- Multithreading
- IDE: Git, Source code management, and build automation
- Project

Project and Teamwork Management

- Project and team work management methods and techniques: goal specification techniques, coordination and collaboration techniques, performance and risk management
- Human resources management: communication, conflict management
- Tool support for project and team work management

Scientific Writing and Communication

- Planning communication: audiences, media and presenters
- In-reach communication: structure of thesis, journal paper, posters, presentation
- Out-reach communication: technical manuals, writing for the web; press release; social media; public dissemination

Software Engineering

- Software life-cycle: principles and methodologies
- Software processes and software project management
- Requirements engineering: elicitation and modeling
- System modeling and construction: UML, design patterns
- Software testing and management: principles and techniques
- Recent software engineering topics: DevOps, Cloud, SE and AI

Software Architecture (cohort from 2020 to 2022) Software Systems Engineering (cohort from 2023, starting a.y 24/25)

Module 1: Software Systems Architecture

- Software and systems architecture principles
- Software architecture design process
- Architectural components and frameworks
- Approaches for architectural partitioning
- Architectural patterns and styles
- Integrating AI Components into Architectural Designs

Module 2:Tools and Techniques for Software Testing

- Verification and validation
- Techniques for black-box and white-box texting
- Techniques and tools for test automation
- Integration and regression testing
- Web testing
- AI for test case generation

Web and Internet Engineering

- Development of web applications: basics of usability, accessibility and responsive design
- Web protocols and markup languages
- Client-side dynamicity and web scripting languages
- Client-side GUI frameworks
- Web application design and web services
- Languages and frameworks for server-side web development