Master of Science
Group G

Courses description

Categories and Computer Science

The course aims to familiarize students with the conceptual apparatus of the theory of categories, but also with the techniques and methods needed to address certain types of problems that frequently appear in Computer Science, particularly those involving structural and functional considerations. The thematic content of the course is the following: 1) Categories, functors and natural transformations. 2) Universal constructions. 3) Data Types, algebras and structural induction. 4) Monads. Prerequisites for this course: elementary notions of propositional logic, set theory and discrete mathematics acquainted from the undergraduate courses Mathematics 1 and Mathematics 2.

Complementary mathematics

The course “Complementary mathematics” is oriented towards the presentation of essential mathematical methods for master students (different disciplines) interested in solving optimization problems.
A part of the course presents optimization methods with real number variables representing instruments of wide interest in engineering: linear programming; alternative strategies for solving linear programs; network flow optimization problems; elements of convex optimization; nonlinear numerical optimization problems (unconstrained and constrained); penalty methods for constrained minimization. One shows also some basic relations between graph theory and optimization.
A second part of this course is oriented to show conections between logic and discrete optimization. Basic notions of mathematical logic and their relations to optimization are introduced: propositional calculus; predicate calculus; consistence and satisfiability; normal forms of formulas; Craig interpolation lemma; complete sets of logical functors; clausal logic and resolution; testing satisfiability using polinomial time algorithms; satisfiability of clausal theories and integer programming.

Computational Geometry

The main branches of Computational Geometry science are algorithmic geometry and geometric modeling. The goal of algorithmic geometry is developing efficient algorithms and data structures for problems stated in terms of geometrical objects (points, lines, polygons). Examples include calculating the convex hull, Voronoi diagram, Delaunay triangulation; finding the shortest path, the closest pair of points, line-segment intersection, ray-casting, range searching, nearest neighbor and many other problems having connections with a large variety of domains not necessarily geometric in nature.
Geometric modeling deals with curve and surface modeling. The most important objects are parametric curves and surfaces and are used to construct geometric surfaces for computer aided engineering.
The course has three main teaching methods: presentation of the theory, held by the teacher; presentations based on cutting-edge research articles sustained by the students; and a project developed by the students, starting from proposed ideas, in-progress projects, or a new idea which students can propose.

Technical Scientific Writing

In the Technical Scientific Writing lecture we present a number of communication techniques in writing and in person. We start by evaluating the intended audience and developing documentation plans. We continue by offering general principles of writing on using words, sentences, paragraphs, sections, lists, tables, and graphics in technical documents. Specific documentation types are then detailed, from manuals, project proposals, lab reports, to scientific posters. The importance of editing documentation is outlined by putting emphasis on checking for quality, fonts, typography, and punctuation. We conclude the lecture by detailing the main stages of realization of successful presentations, namely: preparation, design, and delivery.

Criptography

The *"Cryptography"* course is focused on theoretical and practical cryptographic techniques and methods needed to ensure information security in terms of confidentiality, integrity, authenticity and nonrepudiation of the information. The course addresses both areas of cryptology: cryptography (system design) and cryptanalysis (breaking systems). Thus, are presented, from both perspectives, classical encryption systems (systems that

use usually substitutions, simple or digraph, and transpositions), **asymmetric cryptographic systems** (systems that base their security on the difficulty of solving certain computational problems, such large numbers factorization (RSA), discrete logarithm problem (ElGamal) and elliptic curves) and **symmetric cryptographic systems** (systems for which an estimation of the level of security is based on the minimum amount of information necessary to perform a key search faster than exhaustive search). Also, the courses discuss cryptographic techniques and protocols for key management, such as, for example, public key infrastructure (PKI).

Computer Network Management

Network Management is becoming more and more important to Government, state own institutions and commercial organizations to run their IT networks in an efficient, cost effective and secure manner. The emerging multimedia applications, such as VoIP, IPTV and technologies such as wireless communications make network management all the more important.

The Computer Network Management course provides the theory and the practical skills necessary to understand and apply methods and tools for maintaining a computer network in operation. It offers in-depth study of emerging network management issues such as: network monitoring, network controlling and programming network management applications.

The course covers major network management standards as they apply to data, voice and video services (SNMPv1,v2,v3, MIBII, RMON1&2), ASN.1 language used for representing MIBs, operational procedures, programming network management applications, network management methods and tools (commercial and open source), industry best practices, and case studies. A short introduction to the adjunct services offered by the network forensics methods and tools to the modern computer network management will be also presented.

Hands on labs based on a virtual network management lab located in Germany and videoconferences will accompany the face to face lectures during the entire semester. The projects will be assigned on student groups to stimulate teamwork and innovative solutions on real management problems.

The course will use on-line course material to supplement in class lecture through the online educational platforms situated at the University of Regensburg, Germany: https://comserver.hs-regensburg.de/PMCIO;
http://comserver.hs-regensburg.de/WiWiNET