

Dual PhD Program in Computer Science (Al-Quds Open University and Georgia State University)

Courses Description:

CSC9900 Seminar in Computer Science (1 Credit hour (CrH)).

A research training course, one lecture hour a week. Discussion of current research in computer science

CSC8520 Applied Combinatorics and Graph Theory (3 CrH)

Development of combinatorial and graphical algorithms. Techniques for the study of complexity with application to algorithms in graph theory, sorting, and searching.

CSC8530 Parallel Algorithms (4 CrH)

Techniques for designing and analyzing parallel algorithms on shared-memory and other models. Topics may include basic techniques, lists, trees, searching, sorting, graphs, and randomized algorithms.

CSC8550 Advanced Algorithms with Applications to Networks (4 CrH)

Advanced data structures and algorithms. Linear Programming, Integer Linear Programming, approximation algorithms. Algorithms and protocols for sensor and ad hoc wireless networks. Protocols for improvement of communication networks survivability and reliability.

CSC8560 Discrete Approximation Algorithms and Metaheuristics (4 CrH)

Approximation algorithms and metaheuristics for combinatorial problems: Set Cover, Steiner Trees, Multiway Cut, k-Center, Feedback Vertex Set, Shortest Superstring, Knapsack, Bin Packing, Minimum Makespan Scheduling. Primal-Dual Approximation algorithms: Steiner Forest.

CSC8850 Advanced Machine Learning (4 CrH)

This course is intended to provide a general introduction to machine learning. This course will cover the fundamental concepts and principles of supervised learning and unsupervised learning, including concept learning, decision tree, artificial neural network, evaluating hypotheses, bayesian learning, instance-based learning, genetic algorithm, support vector machine, reinforcement learning, clustering algorithm, feature selection and feature extraction. Students will understand the basic knowledge of machine learning, be familiar with various supervised learning and unsupervised

learning methods, gain experience of designing and implementing machine learning methods for dataset with different characteristics, and develop abilities of conducting research in machine learning.

CSC8210 Advanced Computer Architecture (4 CrH)

Multiprocessors (including shared memory as well as distributed memory systems), vector processing, program and network properties, scalable performance, memory hierarchy (including cache memory organization), pipelining, and bus systems. Topical research papers will also be discussed.

CSC8220 Advanced Computer Networks (4 CrH)

Basics of queuing theory, network simulation, analysis methods, current network protocols, their implementation, potential extensions and improvements. Survey of current literature on performance analysis.

CSC8223 Sensor Networks and Internet of Things (4 CrH)

This course is intended to provide a general introduction to sensor networks and Internet of Things (IoT). The course will cover the fundamental concepts and principles, architectures, communication protocols, synchronization, localization and positioning, topology control, and sensory data management in sensor networks and IoT. Students will understand the basic knowledge of sensor networks and IoT, be familiar with setting up a wireless network consisting of sensor motes, gain experiences of designing and implementing IoT applications, obtain abilities of managing sensory data collected from mobile devices, and develop abilities of conducting research in the areas of sensor networks and IoT.

CSC8320 Advanced Operating Systems (4 CrH)

Advanced operating systems concepts and mechanisms. Topics may include process synchronization, process deadlock, distributed operating systems, atomicity, commitment, recovery, fault-tolerance, distributed leader election, distributed mutual exclusion algorithm, and concurrency control.

CSC8321 Multimedia Systems (4 CrH)

This course covers state of the art on multimedia systems. Course materials consist of a mix of background knowledge, current practice and advanced research. The course is roughly divided into two parts. The first part provides an introduction to networked multimedia systems, including the basics on multimedia compression, and multimedia networking, as well as relevant multimedia applications on video streaming, virtual reality, cloud gaming and video conferencing. The second part presents standalone multimedia systems, discussing the background knowledge on multimedia operating

systems, multimedia analysis and multimedia interaction, as well as corresponding multimedia applications on augmented reality and autonomous vehicles/drones.

CSC8810 Computational Intelligence (4 CrH)

Introduction to computational intelligence techniques and their applications. Major topics include soft computing, granular computing, knowledge discovery and data mining, distributed intelligent agents, etc. How to implement an actual intelligent system is also covered.

CSC8851 Deep Learning (4 CrH)

Deep learning is the most effective learning algorithm so far in the area of Artificial Intelligence and it holds the promise of solving the Artificial General Intelligence (AGI) problem. This course will cover the foundations of deep learning, its training and regularization techniques, and its most prominent architectures (such as CNN, RNN, LSTM) for image recognition, sequence to sequence processing, and multi-modal applications.

CSC8852 Reinforcement Learning (4 CrH)

Reinforcement Learning is a learning paradigm where agents learn by error and trials (without explicit human supervision) to accomplish tasks. It has an enormous range of applications, including robotics, game playing, portfolio management and healthcare. This class will provide a solid introduction to the field of reinforcement learning, its formulation, main learning algorithms and core challenges. We will also cover the latest breakthrough in the intersection of deep learning and reinforcement learning for Atari game playing and Alpha Go.

CSC8050 Statistics for Bioinformatics (3 CrH)

Introduction of computational biology and microarray informatics, gene expression analysis using microarray for transcriptional profiling, use of multivariate statistics and computer algorithms for different clustering techniques, important role of statistical packages, algorithms for calculating statistical quantities and statistical research in this area.

CSC8540 Advanced Algorithms in Bioinformatics (4 CrH)

This course is focused on fundamental algorithmic techniques in bioinformatics, including classical methods such as dynamic programming, support vector machines and other statistical and learning optimization methods. Applications will include restriction mapping, gene prediction, DNA sequencing, phylogenetic trees, haplotype inference, disease association, DNA array analysis, gene networks.

CSC8630 Advanced Bioinformatics (4 CrH)

Advanced topics in bioinformatics, computer and internet tools, and their applications. Computer skills for the analysis and extraction of functional information from biological databases for sequence and structure of nucleic acids and proteins. Students will complete a computer-based bioinformatics project.

CSC8710 Deductive Databases and Logic Programming (4 CrH)

An introduction to the area of deductive databases and logic programming. Topics include syntax of logic programs and deductive databases, model-theoretic, proof-theoretic and fixed-point semantics, operational semantics such as bottom-up evaluation and SLD-resolution techniques, query optimization, negation, constraint checking, and applications of deductive databases.

CSC8711 Databases and the Web (4 CrH)

Application of database technology to access information on the World Wide Web. Topics include Common Gateway Interface (CGI), HTML form processing, accessing databases from the Web, search engines, query languages for Web data, semi-structured data model, and XML.

CSC8712 Advanced Database Systems (4 CrH)

Advanced topics in database systems will be discussed: transaction processing, atomicity-consistency-isolation- durability (ACID) requirements of transactions, transaction processing in Internet, distributed databases, transaction models, concurrency control, middleware in transaction processing systems, application integration, semi- structured data, on-line analytical processing, data warehouses, real-time and active databases.

CSC8713 Spatial and Scientific Databases (4 CrH)

This course will cover a number of advanced concepts: spatial databases, high-dimensional data indexing (with applications in Content-based Image Retrieval through kNN querying), data warehouses, and an introduction to emerging spatio-temporal database systems. The lectures will provide graduate students with sufficient foundation to conduct their own, but supervised research in the field of databases at the graduate level. Students will gain hands on experience on the chosen aspect of database systems through completion of an individual graduate research project.

CSC8740 Advanced Data Mining (4 CrH)

Advanced concepts in data mining: sequence data analysis, time-series data classification and forecasting (with usage of dynamic time warping and kNN

classifiers), high-dimensional data analysis (with applications to high-dimensional data indexing), and emerging area of spatio-temporal patterns discovery. The lectures will provide students with sufficient foundation to conduct their own, but supervised research on the challenges of mining unconventional data (e.g. image, time-series, or spatiotemporal data) from massive real-life data repositories.

CSC8741 Graph Mining (4 CrH)

This course will cover the most important research topics in graph mining including graph generators, proximity measurement, community detection, frequent subgraph mining, influence analysis, and multiplex network analysis. During this course, the students will learn the classic algorithms in graph mining including R-MAT graph generator, PageRank, personalized PageRank, SimRank, spectral clustering, modularity, non-negative matrix factorization, gSpan, influence maximization, and densest subgraph detection. The computational complexity and other properties of the problems are discussed. Fast computing algorithms are also introduced. All students should know the problems and applications in the graph mining research area. Students should only learn basic theoretical formulation/analysis of the methods but also accumulate practical hands-on experience on applying those methods. The students will do assignments, take exams, and finish research -- projects. The students will give presentations about their research projects by the end of the semester.

CSC8260 Advanced Image Processing (4 CrH)

Advanced research topics of image processing, which include image digitization, description, enhancement, segmentation, image transforms, filtering, restoration, coding, and retrieval.

CSC8720 Advanced Human-Computer Interaction (4 CrH)

Current trends in user interface technology; topics include alternative interaction devices, user interface tools, and interface modeling techniques.

CSC8820 Advanced Graphics Algorithms (4 CrH)

Study advanced algorithms and tools for computer graphics programming; topics include 3D pipeline, graphics processing unit, shader programming, view, transformation, texture mapping, game programming, and 3D graphics for mobile devices.

CSC8221 Optical and Wireless Networks (4 CrH)

Topics may include various optical and wireless networks, enabling technologies, multiplexing techniques, WDM, broadcast networks, wavelength-routed networks, network architectures, protocols, personal communication service (PCS) networks, location management, network algorithms, and optimization problems.

CSC8222 Network Security (4 CrH)

This course provides students with a detailed understanding of the fundamentals of network security. Significant focus will be placed on the five phases of network attacks: reconnaissance, scanning, gaining access/denial of service, maintaining access, and covering tracks. Topics to be covered include: Web security, Security standards-SSL/TLS and SET, Intruders and viruses, PGP and S/MIME for electronic mail security, Firewalls, IDS Secret Key and Public/Private Key Cryptography Cryptographic Hashes and Message Digests, Authentication Systems (Kerberos), Digital signatures and certificates, Kerberos and X.509v3 digital certificates. Also, current network security publications will be surveyed.

CSC8250 Advanced Digital Signal Processing (4 CrH)

This course covers the state-of-art network architectures, protocols, and algorithms. It starts with reviewing issues associated with the network design principles, protocol mechanisms, and implementation techniques. The challenges related to implementing efficient and reliable protocols are then discussed and illustrated through several representative techniques and algorithms such as MPLS and RSVP. In addition, the course introduces fault-management and traffic grooming technologies for emerging networks including dynamic optical, radio and overlay networks. Topics related to service classes and network convergences, as well as interactions among diverse networking paradigms are also covered.

CSC8610 Advanced Numerical Analysis (3 CrH)

Advanced topics in numerical analysis. Stability and conditioning, discretization error, and convergence. Examples are drawn from linear algebra, differential and nonlinear equations.

CSC8620 Numerical Linear Algebra (3 CrH)

Computational aspects of linear algebra. Matrix factorization, least squares, orthogonal transformations, eigenvalues, and methods for sparse matrices.

CSC8350 Advanced Software Engineering (4 CrH)

Advanced concepts in software engineering. Topics may include new life cycle paradigms, code reusability issues, formal specifications, new design methodologies, and others.

CSC8840 Modeling and Simulation Theory and Application (4 CrH)

The course covers theory and application of computer modeling and simulation. It includes basic systems modeling concepts and in-depth discussions of modeling elements, simulation protocols, and their relationships. In-class exposition of modeling and simulation techniques will be based on the discrete event modeling and simulation (DEVS) framework. Possible application domains of this class are numerous, including computer network, ecological systems, social/biological systems, and business to name a few.

CSC8224 Cryptography (4 CrH)

This course is intended to provide a general introduction to cryptography. This introductory course will cover a number of fundamental concepts and schemes in cryptography, including symmetric cryptography, stream ciphers, block ciphers, data encryption standard (DES), advanced encryption standard (AES), public-key cryptography, RSA cryptosystem, elliptic curve cryptosystems, digital signatures, hash functions, message authentication codes (MACs), and key establishment. Through the lectures, students will understand the basic knowledge of cryptography, be familiar with various cryptosystems, have sufficient foundation to learn advanced techniques of security, gain experience of implementing cryptosystems, and develop abilities to conduct research in security and privacy.

CSC8228 Privacy Aware Computing (4 CrH)

This course is intended to provide a general introduction to privacy aware computing. This course will cover the fundamental concepts and principles of differential privacy, data perturbation, data anonymization, randomized responses, privacy-preserving data mining, private information retrieval, location privacy, and social network privacy, etc. Students will understand the basic knowledge of privacy aware computing, be familiar with various privacy preserving method, gain experience of designing and implementing methods to defense the privacy leaking with different scenario, and develop abilities of conducting research in privacy aware computing.

CSC8370 Data Security (4 CrH)

The basics of data security and integrity in computer systems. The theoretical basis of data security, including concepts in cryptography, network protocols, operating systems, and authentication. Topics will include the structure, mechanism, and detection of computer viruses and worms; the use of firewalls and packet filters; common security lapses in operating systems and their prevention; checksums and basic cryptography; and related ideas such as buffer overflow attacks and indirect assembly programming. "Real-world" examples of attacks will be analyzed and discussed.

CSC8950 Directed Research in Computer Science (1 - 4 CrH)

Research topic to be determined by the instructor.

CSC8910 Computer Science Topics Seminar (1 - 3 CrH)

Research topic to be determined by the instructor. May be repeated if topic varies.