CS Master Level Courses and Areas

The graduate courses offered may change over time, in response to new developments in computer science and the interests of faculty and students; the list of graduate courses includes (but not limited to):

Area	Course
Systems	CSCI 521 Real-Time Systems CSCI 522 High Performance Computing CSCI 526 Embedded Systems
Theory	CSCI 541 Theory of Computing CSCI 542 Representation and Reasoning CSCI 543 Specification and Verification CSCI 544 Computational Logic CSCI 545 Artificial Intelligence CSCI 554 Matrix Computation CSCI 5xx Data Mining and Machine Learning
Applications	CSCI 561 Computer and Network Security CSCI 562 Computer Graphics CSCI 563 Advanced Database Systems CSCI 564 Constraint Processing and Heuristic Search
Thesis	CSCI 598 Research CSCI 599 Thesis

COURSE DESCRIPTIONS

CSCI 521 Real-Time Systems

Course Description: This course covers analysis techniques and development methodology for real-time systems. Topics include: real-time process and control, soft and hard real time systems, real-time scheduling algorithms, schedulability analysis theory, resource access control, real-time operating systems, real-time communications, performance analysis, requirement specification and system specification, verification of real-time systems, and formal development process of time critical real-time systems.

CSCI 522 High Performance Computing

Course Description: This course is designed for graduate level parallel computing courses. This is not only a course which is linked to real parallel programming software, but also a course which covers many theoretical aspects on architectures, algorithms and applications. This course concentrates on parallel program to be executed not only on special multiprocessor systems or supercomputers, but also on networked workstations (Linux) or PCs using freely available parallel software tools such as Message Passing Interface (MPI) and Parallel Virtual Machine (PVM). Some emerging topics such as cluster computing, grid computing, cloud computing, peer-to-peer computing, as well as multicore systems will be introduced.

CSCI 526 Embedded Systems

Course Description: This course will study embedded programming with a focus on wireless sensor networks, and the state of the art in mobile communication research. Students are expected to present research papers from the recent literature, and to learn TinyOS programming with NesC and application development in MICA2 platform.

CSCI 541 Theory of Computing

Course Description: This course focuses on three areas central to the theory of computation: automata, computability and complexity, to investigate the question: What are the fundamental capabilities and limitations of computers? We study automata (models of computation) e.g., finite state machines, pushdown automata and Turing machines and the languages recognized by them. We investigate complexity theory, to classify problems as easy or hard and computability theory to classify problems as solvable or not.

CSCI 542 Representations and Reasoning

Course Description: This course provides a survey of general methods for analyzing knowledge about the real world and mapping it to a computable form. Principles of knowledge representation and their role in adapting logic and ontology to the task of constructing computable models of an application domain are introduced. Methods for representing dynamically changing processes and events are presented. Ways of dealing with vague, uncertain, imprecise or inconsistent facts are discussed.

CSCI 543 Specification and Verification

Course Description: Topics covered include: introduction to formal methods; propositional and predicate logic; verification and model checking; Hoare-style program verification; modeling systems; specification using temporal (e.g., CTL, LTL), and other modal logics; various model checkers; partial order reduction; compositional reasoning and abstraction; automated theorem proving using tableau; problems/challenges to effective verification of large scale systems.

CSCI 544 Computational Logic

Course Description: This course focuses on automated theorem proving. We start with a rigorous treatment of propositional and first order calculus (with equality) and the method of natural deduction, giving a thorough investigation of the soundness and completeness proofs and decidability. Then we compare and contrast several automated theorem proving methods such as tableau, resolution, sequent style calculus and rewrite systems. Extensions to other logics will be discussed. Students will implement one of the automated theorem proving methods.

CSCI 545 Artificial Intelligence

Course Description: A broad overview of the core concepts and major subfields of artificial intelligence (AI). Topics covered include intelligent agents, uninformed and informed (heuristic) search, logical and probabilistic knowledge representation, logical and probabilistic inference, essentials of machine learning, neural networks, reinforcement learning, and evolutionary computation. Graduate students taking this course for graduate credit in the M.Sc. CS program will: (a) complete assignments which will include additional and/or more challenging problems; (b) complete additional assignments; (c) write exams that will include additional and/or more challenging questions; and (d) complete an individual Project which will require and in-depth study of a topic related to AI.

CSCI 554 Matrix Computation

Course Description: Through the use of lectures, discussions, the text, assignments, and labs, this course will familiarize students with the advanced knowledge of triangular systems, positive definite systems, banded systems, sparse positive definite systems, general systems; Sensitivity of linear systems; orthogonal matrices and least squares; singular value decomposition; eigenvalues and eigenvectors; and QR algorithm with their applications.

CSCI 561 Computer and Network Security

Course Description: The objective of the course is to provide a broad overview of issues and approaches, while exposing students to recent advance of computer and network security. This course will cover the theory and practice of computer and network security. While covering the theory of computer communications security, the course will focus on using and in some cases implementing various algorithms as well.

CSCI 562 Computer Graphics

Course Description: Fundamental mathematical, algorithmic and representational issues in computer graphics. Graphics programming. Geometrical objects and transformations. 2-D and 3-D data description and manipulation. Viewing, Projections, Clipping, Shading, Animation. 2-hours laboratory.

CSCI 563 Advanced Database Systems

Course Description: Explores advanced and evolving issues in database management systems. Topics include advanced database design and normalization, database implementations and optimizations, advanced and embedded SQL, ODBC and JDBC, XML, data warehousing, and emerging database trends. A major project is a key component of the course.

CSCI 564 Constraint Processing and Heuristic Search

Course Description: The course will examine combinatorial problem solving and optimization with constraint processing and heuristic search methods for a variety of real world applications. It contains two main parts. The first part covers basic and advanced search techniques and the second part studies constraint processing techniques and constraint programming

CSCI 5xx Data Mining and Machine Learning

Course Description: The course covers the most current techniques used in data mining and machine learning and their background theoretical results. Two basic groups of methods are covered in this course: supervised learning (classification or regression) and unsupervised learning (clustering). The supervised learning method includes Recursive Partitioning Tree, Random Forest, Linear Discriminant and Quadratic Discriminant Analysis, Neural Network, Support Vector Machine. The unsupervised learning method includes Hierarchical Clustering, K-means, K-nearest-neighbour, model-based clustering methods. Furthermore, the course also covers the dimensional reduction techniques such as LASSO and Ridge Regression, and model checking criteria.

CSCI 598 Research

Course Description: Research necessary for the development of a Thesis Proposal will be accomplished in this course. The student will conduct background research in their area of interest, and with consultation and close interaction with his/her thesis supervisor, s/he will develop a thesis proposal which will review the background literature, pose a specific research question and discuss a methodology to address the problem. The written proposal will be handed in to the supervisory committee and an oral thesis proposal presentation will be made to the department. The supervisory committee will determine the suitability of the thesis project and make suggestions and modifications to the proposal as necessary.