Master of Science in Computer Science

Background/Rationale

The MSCS program aims to provide both breadth and depth of knowledge in the concepts and techniques related to the theory, design, implementation, and applications of computer systems. Students are required to take courses, which cover advanced topics in theoretical computer science and computer systems. Students of the MSCS program are expected to write a thesis under the guidance of a faculty adviser. However, a student may elect to take additional courses in lieu of writing a thesis. Full-time students should be able to complete the program in two years.

Requirements

1. Applicants must have at least a bachelor's degree in Computer Science, Engineering, Mathematics or other fields, which provide a substantial background in computing.
2. Applicants must demonstrate proficiency in at least one high-level programming language prescribed by the department's graduate committee.
3. Applicants must have a general knowledge of Computer Science. This may include, but is not limited to, the following:
   a. Data Structures
   b. Theory of Computation
   c. Discrete Mathematical Structures
   d. Algorithms
   e. Computer Networks
   f. Database Systems
   g. Software Engineering
4. Applicants must get their endorsement by one of the department's six (6) research laboratories.

Curriculum

Core Courses:

One (1) Theory Course	3 units
One (1) Systems Course	3 units
One (1) Theory or Systems Course	3 units
CS 298 Special Problem	3 units
	12 units

In addition, students need to take the following:

CS 296 Seminar	1 unit

Thesis Option:		**Non-Thesis Option:**	
Specialization Courses	9 units	Specialization Courses	12 units
Elective	3 units	Computer Science elective	3 units
CS 300 Thesis	6 units	Elective	9 units
Total for Thesis Option:	30 units	Total for Non-Thesis Option:	36 units

Core Courses in Theory:

CS 204 (Theory of Computation)
CS 210 (Advanced Algorithms and Data Structures)

Core Courses in Systems:

CS 220 (Survey of Programming Languages)
CS 250 (Advanced Operating Systems)
CS 255 (Advanced Computer Networks)
CS 260 (Advanced Software Engineering)
CS 270 (Advanced Database Systems)
CS 280 (Intelligent Systems)

Specialization Courses should be taken from either Theory or Systems.
Specialization Courses:

Theory:
CS 204 Theory of Computation
CS 208 Complexity Theory
CS 210 Advanced Algorithms and Data Structures
CS 211 Combinatorial Optimization
CS 213 Communication Theory
CS 214 Parallel Algorithms
CS 216 Randomized Algorithms
CS 222 Programming Language Theory
CS 225 Compiler Design and Construction
CS 231 Numerical Computing
CS 236 Scientific Computing
CS 247 Cryptography
CS 271 Database Theory
CS 290 Advanced Topics in Theoretical Computer Science
CS 294 Advanced Topics in Computational Science
CS 297 Special Topics
CS 298 Special Problems
ES 201 Advanced Mathematical Methods in Engineering I
ES 202 Advanced Mathematical Methods in Engineering II

Systems:
CS 220 Survey of Programming Languages
CS 237 Biomedical Informatics
CS 239 Parallel Computing
CS 240 Computer Graphics
CS 242 Data Visualization
CS 250 Advanced Operating Systems
CS 253 Computer Security
CS 255 Advanced Computer Networks
CS 256 Computer Systems Performance Analysis
CS 257 Distributed Systems
CS 258 Mobile Computing
CS 259 Network Performance, Modeling and Monitoring
CS 260 Advanced Software Engineering
CS 262 Methods of Software Development
CS 265 Software Quality Assurance
CS 266 IT Project Management
CS 267 Software Engineering for the Web
CS 268 Web Science
CS 270 Advanced Database Systems
CS 280 Intelligent Systems
CS 281 Robotic Systems
CS 282 Computer Vision
CS 283 Data Mining
CS 284 Machine Learning
CS 286 Natural Language Understanding
CS 291 Advanced Topics in Net-Centric Computing
CS 292 Advanced Topics in Software Technology
CS 293 Advanced Topics in Computer Systems
CS 295 Advanced Topics in Intelligent Systems
CS 297 Special Topics
CS 298 Special Problems
EE 227 Modern VLSI Design
EE 267 Real-Time Systems
EE 270 Digital Communication I
EE 274 Digital Signal Processing I
EE 264 Computer Architecture
GE 203 Principles of Geographic Information Systems
GE 213 Advanced Geographic Information Systems
IE 253 Information Systems I
IE 253 Information Systems II

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Course Description

Course No.	Course Name	Course Description	Prerequisite/ Corequisite	Credits
CS 204	Theory of Computation	Formal models of computation; recursive function theory; undecidability. Resource-bounded computational complexity, non-determinism, NP-completeness.	Pre: CS 133 or COI	3 u.
CS 208	Complexity Theory	Computational models, measures of complexity, complexity classes: nondeterministic, alternating, probabilistic, parallel. Boolean circuits. Complete problems.	Pre: CS 204	3 u.
CS 210	Advanced Algorithms and Data Structures	Advanced data structures: algorithm design techniques; mathematical techniques in the analysis of algorithms.	Pre: CS 135	3 u.
CS 211	Combinatorial Optimization	Design and analysis of algorithms for combinatorial optimization problems, worst-case complexity, NP-Completeness proofs, heuristics. Open problems.	Pre: COI	3 u.
CS 213	Communications Theory	Mathematical theiry of communication. Information Theory. Communication Channels. Coding. Cryptography.	Pre: COI	3 u.
CS 214	Parallel Algorithms	Models of parallel computation. Performance measures, scalability, pipelining, techniques for analyzing parallel algorithms. Interconnection network topologies. Applications.	Pre: COI	3 u.
CS 216	Randomized Algorithms	Construction and analysis of randomized algorithms. Expected performance of randomized algorithms, fundamental limitations on probabilistic computations, complexity issues, applications.	Pre: CS 135, Stat 112 or COI	3 u.
CS 220	Survey of Programming Languages	Comparative study of different types of modern programming languages: imperative, functional, logic-based and object-oriented. Syntax, semantics and implementation of programming languages.	Pre: CS 150 or equiv.	3 u.
CS 222	Programming Language Theory	Fundamental concepts underlying all programming languages. Semantic aspects including binding times, visibility, retention, storage management, abstraction mechanisms and extensibility. Operational and denotational semantic specifications.	Pre: CS 150 or equiv.	3 u.
CS 225	Compiler Design and Construction	Theory of compiler design and construction; techniques on error connection and recovery; code generation and optimization.	Pre: CS 220	3 u.
CS 231	Numerical Computing	Algorithm design for numerical computation. Error analysis. Performance evaluation of numerical software.	Pre: CS 131 or COI	3 u.
CS 236	Scientific Computing	Problems and methods in scientific computing. Applications from science and engineering.	Pre: COI	3 u.
CS 237	Biomedical Informatics	Computational methods for managing and analyzing information about biomedical systems. Standards and tools in Biomedical Informatics.	Pre: COI	3 u.
CS 239	Parallel Computing	Parallel computer architectures, Programming for parallel architectures. Representation, program dependence, control structures.	Pre: COI	3 u.
CS 240	Computer Graphics	Solid modelling: Euler operators, finite element methods. Rendering: filling, shading, ray tracing. Natural modelling: L-systems, fractals. Image processing: filtering, antialiasing, enhancement.	Pre: COI	3 u.
CS 242	Data Visualization	Visualization techniques for data from science, business, social science, demographics, and information management.	Pre: COI	3 u.
CS 247	Cryptography	Primality testing, finite fields, elliptic curves. Protocols: public key cryptography, digital signatures, zero-knowledge proofs, and other cryptographic protocols.	Pre: COI	3 u.
CS 250	Advanced Operating Systems	Synchronization and communication mechanisms; virtual memory management, file systems, deadlock control, resource allocation, protection and access control. Case study of specialized systems.	Pre: CS 140 or equiv	3 u.
CS 253	Computer Security	Encryption, digital signatures, authentication, key	Pre: COI	3 u.

		management. Secure electronic commerce. Network security. File security.		
CS 255	Advanced Computer Networks	The five-layer reference model: physical, data link, network, transport, application. Distributed computing. Networked multimedia systems. Client0server computing. Communication and internetworking.	Pre: CS 250	3 u.
CS 256	Computer Systems Performance Analysis	Overview of performance evaluation. Measurement techniques and tools. Applications of probability theory and techniques. Experimental design and analysis. Simulation and queuing models.	Pre: COI	3 u.
CS 257	Distributed Systems	Computer communications networks and their protocols. Event ordering and synchronization. Deadlocks. Network operating systems and languages for distributed computing. Distributed databases. Fault tolerance and recovery strategies. Applications.	Pre: CS 140 or equiv.	3 u.
CS 258	Mobile Computing	Mobile computing systems. Data management, packet transmission, mobile IP, routing protocols, reliability and issues in mobile wireless networks.	Pre: COI	3 u.
CS 259	Network Performance, Modeling and Monitoring	Network Performance Evaluation. Measurement Techniques and Tools. Simulation, queuing models, case studies, practicals.	Pre: CS 255, CS 256 or COI	3 u.
CS 260	Advanced Software Engineering	Structured approach to requirements analysis, system design, implementation and maintenance of software systems. Formal description and documentation techniques.	Pre: CS 192 or equiv.	3 u.
CS 262	Methods of Software Development	Modern approaches to software development. Prototyping and automated tools. Computer Aided Systems Engineering (CASE) methods and tools. Object-oriented Programming Systems (OOPS).	Pre: CS 260	3 u.
CS 265	Software Quality Assurance	Quality Management, Quality Assurance, Quality Control. Measurement and Analysis. Maturity Models.	Pre: CS 260 or COI	3 u.
CS 266	IT Project Management	Detailed discussions of project management knowledge areas and processes. Case studies. Simulations and walkthrough of real-world IT projects from initiation and planning to evaluation and closing.	Pre: COI	3 u.
CS 267	Software Engineering for the Web	Software processes and requirements analysis, design, development and testing for web-based systems, software development tools, configuration management systems, case studies.	Pre: CS 260, CS 270 or COI	3 u.
CS 268	Web Science	The Web as a full communications medium that foster full collaboration, social interaction and commerce. Case studies.	Pre: CS 267	3 u.
CS 270	Advanced Database Systems	Data models and their underlying mathematical foundations; database manipulation and query languages; functional dependencies; physical data organization and indexing methods; concurrency control; crash recovery; database security; distributed databases.	Pre: CS 250	3 u.
CS 271	Database Theory	Relational database model, query languages, domain independence, relational calculus, query optimization, constraints.	Pre: CS 165 or equiv.	3 u.
CS 280	Intelligent Systems	Fundamental issues in Intelligent Systems. Intelligent search and optimization methods. Knowledge representation and reasoning. Learning, natural language understanding, pattern recognition, knowledge-based systems and other methods in intelligent systems.	Pre: COI	3 u.
CS 281	Robotic Systems	Biologically-motivated robotic systems. Reactive, deliberative, and hybrid architectures. Knowledge representation for robotic systems. Sensor fusion and perceptual strategies. Adaptation and Social behavior.	Pre: CS 280 or equiv.	3 u.
CS 282	Computer Vision	Image formation. Early vision. Segmentation from texture and motion. Object representation. Matching and Inference. Knowledge-based vision.	Pre: COI	3 u.
CS 283	Data Mining	Decision trees, association rules, clustering. Intrusion detection. Design and use of serial, distributed and parallel data mining algorithms.	Pre: CS 165, CS 280 or COI	3 u.
CS 284	Machine Learning	Pattern recognition, parametric and non-parametric	Pre: CS 280 or	3 u.

		learning, decision trees, Bayesian and neural networks, reinforcement learning, genetic algorithms, computational learning theory.	COI	
CS 286	Natural Language Understanding	Computational properties if natural languages. Morphological, syntactic and semantic processing from an algorithmic perspective. Models of acquision and parsing.	Pre: CS 280 or COI	3 u.
CS 287	Speech Processing	Models of speech processing, speech recognition and synthesis. Speech recognition systems. Text-to-speech systems. Applications.	Pre: CS 280 or COI	3 u.
CS 290*	Advanced Topics in Theoretical Computer Science	-	Pre: COI	3 u.
CS 291*	Advanced Topics in Net-Centric Computing	-	Pre: COI	3 u.
CS 292*	Advanced Topics in Software Technology	-	Pre: COI	3 u.
CS 293*	Advanced Topics in Computer Systems	-	Pre: COI	3 u.
CS 294*	Advanced Topics in Computational Science	-	Pre: COI	3 u.
CS 295*	Advanced Topics in Intelligent Systems	-	Pre: COI	3 u.
CS 296	Seminar	-	Pre: COI	1 u.
CS 297*	Special Topics	-	Pre: COI	3 u.
CS 298*	Special Problems	-	Pre: completion of 12 u. including 6 u. of Specialization courses	3 u.
CS 300	Thesis	-	-	6 u.

* may be repeated for a maximum of 6 u.; topic should be indicated for record purposes
COI: Consent of Instructor