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LaGrange College

Course Catalog - M.S. in Computer Science

MS in Computer Science - M.S. in Computer Science

Type: Major

The M.S. in Computer Science is a 30-hour program designed to prepare students to work in computing- and technology-related fields. Courses will be eight (8) weeks in length (two sequential courses in each traditional semester) and delivered in multiple formats. The coursework will be taught using a mixture of synchronous and asynchronous online delivery, as well as in a hybrid format. While most work will be completed online, students will come to LaGrange's campus 1 – 2 times every semester for instruction.

The MSCS is designed for recent baccalaureate graduates who wish to earn a master's degree in preparation for industrial or government employment or for ongoing studies in computer science. The program will be promoted to those who possess a baccalaureate degree in computer science or a related field and wish to advance their studies in the field.

Students will be required to have:

- A completed application for admission
- A bachelor's degree in computer science or a related field from an accredited institution prior to matriculation in this program, and
- An undergraduate cumulative GPA of at least 3.0 on a 4.0 scale (or equivalent).

Students will follow a cohort-based model and will have two pathways through the curriculum from which to choose. All courses will occur in eight-week blocks, either in the first half or second half of a traditional semester.

1. Students may choose a standard pathway, in which they will only take two courses in each term (e.g., fall, spring, summer). Taken this way, the full program will take five terms to complete, i.e., two academic years and one summer in between, or approximately 21 calendar months.
2. Students may choose to complete this program on an accelerated schedule in only three terms, i.e., fall, spring, and summer. Students will take three (3) courses in the first term, four (4) in the second term, and three (3) in the third term. Taken together, the accelerated pathway will allow a student to complete the degree in approximately 12 calendar months.

Student learning outcomes and program objectives in MSCS are professional competencies expected for practitioners in the field. By the end of the program, students should be able to

- Apply important concepts or techniques related to computer science and computer security,
- Demonstrate an understanding of advanced concepts in computer science, including machine learning, scientific computing, and algorithms,
- Perform critical analysis of complex computing situations and offer and evaluate solutions,
- Communicate information accurately and professionally both orally and in writing, and
- Demonstrate knowledge of current computing technologies and awareness of continued advances in the field.

CSCI 5100 - Theory of Computation

Study of abstract models of computation, unsolvability, complexity theory, formal grammars and parsing, and other advanced topics in theoretical computer science.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 5200 - Machine Learning

Introduction to machine learning, including computational learning theory, major approaches to machine learning, evaluation of models, and current research.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 5200 - Computing Security

This course provides a graduate-level introduction to computer and network security and privacy. Students successfully completing this class will be able to evaluate works in academic and commercial security, and will have rudimentary skills in security research. The course covers four key topic areas: basics of cryptography and crypto protocols, network security, systems security, and privacy. Readings primarily come from seminal papers in the field.

Upon completion, students will be able to:

- Students will demonstrate an understanding of computer and network security fundamentals. Successful students will be able to explain key concepts related to confidentiality, integrity, and availability, in addition to recognizing the ethical and legal implications of security practices.
- Students will demonstrate understanding of the basics of cryptography and cryptography protocols. They will learn about encryption algorithms, digital signatures, and secure communication protocols.
- Students will demonstrate understanding of network security, including topics such as firewalls, intrusion detection systems, and secure network design. They will develop skills to analyze network vulnerabilities, propose effective defense mechanisms, and mitigate security risks.
- Students will study systems security, focusing on securing operating systems, servers, and software applications. They will demonstrate techniques for hardening systems, access control, and vulnerability assessment.
- Students will engage with seminal research papers in the field of security. They will learn to critically evaluate academic and commercial security works, contributing to the advancement of their knowledge in the domain of computer and network security.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 5400 - Scientific Computing

A study of high-performance computing for advanced scientific research on modern processors. Topics include high-performance computing techniques, floating point properties, and advanced numerical methods.

Upon completion, students will be able to:

- Master Floating Point Properties: Students will communicate understanding of floating point properties and their implications in scientific computations.
- Understand High-Performance Computing: Students will apply high-performance computing techniques to solve complex, real-world, scientific problems.

- Optimize Scientific Computations: Students will optimize scientific computations for modern processors, taking into account factors such as memory hierarchy and parallelism.
- Evaluate Computational Approaches: Students will critically evaluate different computational approaches and algorithms for their efficiency, accuracy, and suitability to specific scientific problems.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 5500 - Numerical Analysis

Algorithm behavior and applicability. Effect of roundoff errors, systems of linear equations and direct methods, least squares via Givens and Householder transformations, stationary and Krylov iterative methods, the conjugate gradient and GMRES methods, convergence of method.

Upon completion, students will be able to:

- Analyze the behavior and applicability of numerical algorithms, considering factors such as stability, accuracy, and efficiency.
- Implement direct methods for solving systems of linear equations, including techniques like Gaussian elimination with partial pivoting.
- Apply least squares methods using Givens and Householder transformations to approximate solutions for overdetermined systems.
- Evaluate the effectiveness of stationary and Krylov iterative methods, including the conjugate gradient and GMRES, in solving linear systems.
- Assess the convergence properties of numerical methods and understand their limitations.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 5600 - Practicum

The practicum serves as a bridge between academia and industry to build practical experience in the field of computer science. Students will collaborate with approved industry professionals, research institutions, or technology companies to enhance their communication, teamwork, and problem-solving skills. May be taken for variable amounts of credit.

Upon completion, students will be able to:

- Collaborate with industry professionals, research institutions, or technology companies to creatively solve real-world problems.

- Demonstrate communication skills that are relevant to computer science.
- Demonstrate critical thinking skills by reflecting upon the experiences of their practicum.

Grade Basis: P
Credit hours: 3.0
Lecture hours: 3.0

CSCI 6100 - Algorithmic Analysis

Techniques for designing efficient algorithms; analysis of algorithms; lower bound arguments; and algorithms for sorting, selection, graphs, and string matching.

Upon completion, students will be able to:

- Express understanding of algorithm design techniques, including dynamic programming, divide and conquer, and greedy algorithms. Students will apply these paradigms to solve complex problems related to sorting, selection, graphs, and string matching.
- Analyze the asymptotic performance of algorithms, understanding their efficiency in terms of complexity. Students will evaluate worst-case running times using Big O notation and other asymptotic measures.
- Prove the validity of algorithms using inductive reasoning and invariants and will demonstrate that an algorithm produces the expected output for all possible inputs.
- Investigate graph theory, exploring algorithms for depth-first search, connected components, and shortest paths. They will model engineering problems using graphs and synthesize new graph algorithms.
- Express understanding of computational intractability and the theory of NP-completeness. They will explore lower bound arguments, recognizing limits on algorithmic efficiency for certain problems.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 6200 - Operating Systems

Introduction to operating systems concepts. Topics include multiprogramming, resources allocation and management, and their implementation.

Upon completion, students will be able to:

- Express the core concepts of operating systems, including process management, memory management, and file systems.
- Analyze and evaluate the strategies for allocation and management of resources in an operating system.

- Implement basic multiprogramming concepts including process scheduling and inter-process communication.
- Develop simple components of an operating system, particularly a scheduler or memory manager.
- Evaluate the performances associated with design choices in operating systems.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 6300 - Software Engineering

Techniques used in large scale scientific or technical software development, including requirements analysis, specification, systems design, implementation, testing, validation, verification, and maintenance.

Upon completion, students will be able to:

- Analyze complex software requirements and translate them into clear and concise specifications.
- Demonstrate proficiency in designing software systems, considering factors such as modularity, scalability, and maintainability.
- Implement software solutions using appropriate tools and frameworks
- Demonstrate the skills of testing, validation, and verification of software components and systems to ensure correctness and reliability.
- Express the importance of maintenance and evolution in software engineering, including techniques for enhancing and adapting existing systems.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 6400 - Computer Forensics

Introduction to computer crime and the study of evidence for solving computer-based crimes. Topics: computer crime, computer forensics and methods for handling evidence.

Upon completion, students will be able to:

- Conduct digital forensics investigations, including understanding the concept of the chain of evidence.
- Effectively communicate findings from digital forensic investigations.
- Recover digital evidence from various digital.
- Analyze potential security breaches of computer data, identifying violations of legal, ethical, moral, policy, and societal standards.

- Effectively communicate the results of computer, network, and data forensic analyses.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

CSCI 6900 - Capstone

Students will complete a group project on a computing-related issue and provide a public presentation to the college community.

Upon completion, students will be able to:

- Deliver a well-structured and engaging public presentation on their group project, effectively communicating their findings and insights to the college community.
- Synthesize information from various sources, integrating theoretical knowledge, practical experience, and critical analysis as part of their presentation.
- Collaborate to manage their term-long project, build their own presentation, and will evaluate that of their peers during the presentation, reflecting on strengths, areas for improvement, and the overall effectiveness of their communication.

Grade Basis: L
Credit hours: 3.0
Lecture hours: 3.0

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