Program Overview

The Data Science concentration covers the foundations of data science and exposes students to up to date theories, techniques, and practices of data science field.

Data science, which encompasses big data, employs machine learning, artificial intelligence (AI), statistical and other advanced models and techniques on big data. The work of data science can help identify valuable knowledge that is impossible or extremely difficult to obtain previously. Those knowledge and findings can help organizations understand their strengths and weakness and make meaningful and effective changes.

As such, data science has emerged as one of hottest areas in computer science and demand for computer science professionals with expertise in data science has been rising constantly and rapidly. Major tech companies all actively recruit computer science professionals with data science expertise. Students who graduate with the proposed concentration will work as data scientists, data science engineers, data analysts, big data system analysts, and software developers.

Application Requirements

The items listed below are required for admission consideration for applicable semesters of entry during the current academic year. Submission instructions, additional details, and changes to admission requirements for semesters other than the current academic year can be found on The Graduate College's website (http://www.gradcollege.txstate.edu). International students should review the International Admission Documents page (http://mycatalog.txstate.edu/graduate/admission-documents/international/) for additional requirements.

- completed online application

- $55 nonrefundable application fee

    or

- $90 nonrefundable application fee for applications with international credentials
- baccalaureate degree from a regionally accredited university (Non-U.S. degrees must be equivalent to a four-year U.S. Bachelor's degree. In most cases, three-year degrees are not considered. Visit our International FAQs (https://www.gradcollege.txst.edu/international/faqs.html) for more information.)
- official transcripts from **each institution** where course credit was granted
- 2.75 overall GPA or a 2.75 GPA in the last 60 hours of undergraduate course work (plus any completed graduate courses)
- background course work*
- official GRE (general test only) with competitive scores in the verbal reasoning and quantitative reasoning sections
    - The GRE may be waived if the student holds a master's or doctoral degree from a regionally accredited U.S. institution. If the student holds a master's or doctoral degree (or the equivalent thereof) from an accredited international institution, the GRE may be waived on an individual basis.

- resume/CV

- statement of purpose
- three letters of recommendation

Approved English Proficiency Exam Scores

Applicants are required to submit an approved English proficiency exam score that meets the minimum program requirements below unless they have earned a bachelor's degree or higher from a regionally accredited U.S. institution or the equivalent from a country on our exempt countries list (http://www.gradcollege.txstate.edu/international/language.html#waiver).

- official TOEFL iBT scores required with a 78 overall
- official PTE scores required with a 52 overall
- official IELTS (academic) scores required with a 6.5 overall and minimum individual module scores of 6.0
- official Duolingo scores required with a 110 overall
- official TOEFL Essentials scores required with an 8.5 overall

*Additional Information

Students admitted to the program will participate in a diagnostic interview with the graduate advisor. This interview will include a review of test scores, grades, and work history. In some cases, additional courses may be added to the degree program.

Degree Requirements

The Master of Science (M.S.) degree with a major in Computer Science concentration in Data Science requires 30 semester credit hours, including a thesis.

Background Requirements

Students are required to fulfill background course work if they do not have adequate undergraduate computer science background. The background requirements may be reduced if evidence is presented which shows that the applicant has taken equivalent courses elsewhere prior to enrollment at Texas State. Background work must be completed before enrolling in graduate courses.

The minimum undergraduate background requirements for computer science majors are:

Code	Title	Hours
Computer Science [1]		
CS 1428	Foundations of Computer Science I	4
CS 2308	Foundations of Computer Science II	3
CS 2318	Assembly Language	3
CS 3339	Computer Architecture	3
CS 3358	Data Structures and Algorithms	3
CS 4318	Compiler Construction	3
or CS 4328	Operating Systems	
Advanced computer science electives (3000-4000 level)		6
Mathematics [2]		
MATH 5358	Applied Discrete Mathematics	3
Calculus		8

[1] These courses must be completed with no grade less than "C" and no more than two "Cs."

2 These courses must be completed with no grade less than "C."

Course Requirements

Code	Title	Hours
Required Courses		
CS 5318	Principles of Programming Languages	3
or CS 5338	Formal Languages	
or CS 5351	Parallel Processing	
CS 5329	Algorithm Design and Analysis	3
CS 5332	Data Base Theory and Design	3
CS 5346	Advanced Artificial Intelligence	3
Concentration		
CS 7311	Data-Driven Computational Methods and Infrastructure	3
CS 7312	Advanced Data Mining	3
CS 7313	Advanced Machine Learning and Pattern Recognition	3
Electives		
Choose 3 hours from the following:		3
CS 5306	Advanced Operating Systems	
CS 5310	Network and Communication Systems	
CS 5316	Data Mining	
CS 5318	Principles of Programming Languages	
CS 5326	Advanced Studies in Human Factors of Computer Science	
CS 5331	Crafting Compilers	
CS 5334	Advanced Internet Information Processing	
CS 5338	Formal Languages	
CS 5341	Advanced Network Programming	
CS 5343	Wireless Communications and Networks	
CS 5351	Parallel Processing	
CS 5352	Distributed Computing	
CS 5369J	Advanced Human Computer Interaction	
CS 5369L	Machine Learning and Applications	
CS 5369Q	Recommender Systems	
CS 5369Y	Green Computing	
CS 5375	Multimedia Computing	
CS 5378	Advanced Computer Security	
CS 5388	Advanced Computer Graphics	
CS 5389	Graphical User Interfaces	
CS 5391	Survey of Software Engineering	
CS 5392	Formal Methods in Software Engineering	
CS 5393	Software Quality	
CS 5394	Advanced Software Engineering Project	
CS 5395	Independent Study in Advanced Computer Science	
Thesis		
CS 5399A	Thesis	3
Choose a minimum of 3 hours from the following:		3
CS 5199B	Thesis	
CS 5299B	Thesis	
CS 5399B	Thesis	
CS 5599B	Thesis	
CS 5999B	Thesis	
Total Hours		**30**

Comprehensive Examination Requirement

The comprehensive exams of computer science master programs consist of multiple components. Specifically, all Computer Science graduate students must complete/pass:

1. **Degree Outline:** Have a degree outline prepared before the end of their first semester. Currently, this is done during the mandatory diagnostic interview sessions for newly admitted CS master degree students.
2. **Programming exam:** Pass a written exam in programming.
3. **Communication exam**: Pass a written exam in communication.
4. **Attendance requirement of computer science seminars.**
5. For non-thesis students, the **written core course exam**.

Failure to complete 1, 2, or 3 will result in a "hold" on registration and may cause delays in taking/passing the comprehensive examination. Details of 2, 3, 4, and 5 are described below.

Programming Exam

The Programming Exam integrates problem-solving and technical abilities to write clear and logical code. The exam format is written.

- The allowable programming languages are C++/Java. Students can elect either of the two.
- This exam is given to newly admitted graduate students twice a year. Students are notified of the registration by the department for the exam. A student who doesn't participate in the exam without the department approval forfeits the opportunity of taking the exam and must take the remedy course CS 5301.
- The exam is typically administrated during the week before the fall or spring semester starts.
- Students who fail the Programming Exam are required to take the remedy course CS 5301 immediately. Students must obtain a grade C or higher of CS 5301 in order to satisfy the programming exam requirement. Students are allowed to take CS 5301 twice.
- Students who have not passed the Programming Exam or the remedy course, CS 5301, are not eligible to take classes during the summer semesters.

Communication Exam

The Communication Exam tests the ability to write clear technical English on computer science topics. All students must satisfy one of the following three options:

- Have a score of 3.5 or higher on the Analytical Writing section of the Graduate Record Examination (GRE).
- Take the Communication Exam and earn a passing score in the first long semester.
    1. This exam is given to newly admitted graduate students during their first semester (Spring or Fall semester only).
    2. Students are registered and notified by the department for this exam.
    3. This exam can only be taken once during the first semester of initial enrollment.

- Complete one of the following Texas State English courses, ENG 3313, ENG 3311, or ENG 3303, and earn a grade of B or higher. Students must register for one of the English courses by the end of the student's first year in the graduate program. There is no limit on the number of times the students can take those English courses.

Seminar Attendance

All computer science master students are required to attend at least **four** computer science departmental seminars. All seminars that can be counted toward this requirement are announced by the department through emails to all active students and on the department website. Students are strongly recommended to plan and participate in seminars earlier and not to wait until the final semester of their study.

Oral Master Thesis Defense Exam

All thesis students are required to take an oral exam at the time of their public thesis defense.

Students who do not successfully complete the requirements for the degree within the timelines specified will be dismissed from the program.

If a student elects to follow the thesis option for the degree, a committee to direct the written thesis will be established. The thesis must demonstrate the student's capability for research and independent thought. Preparation of the thesis must be in conformity with the *Graduate College Guide to Preparing and Submitting a Thesis or Dissertation*.

Thesis Proposal (http://www.gradcollege.txstate.edu/docs/Thesis_Diss_Guide.pdf)

The student must submit an official Thesis Proposal Form (http://www.gradcollege.txstate.edu/forms.html) and proposal to his or her thesis committee. Thesis proposals vary by department and discipline. Please see your department for proposal guidelines and requirements. After signing the form and obtaining committee members' signatures, the graduate advisor's signature if required by the program and the department chair's signature, the student must submit the Thesis Proposal Form with one copy of the proposal attached to the dean of The Graduate College for approval before proceeding with research on the thesis. If the thesis research involves human subjects, the student must obtain exemption or approval from the Texas State Institutional Review Board prior to submitting the proposal form to The Graduate College. The IRB approval letter should be included with the proposal form. If the thesis research involves vertebrate animals, the proposal form must include the Texas State IACUC approval code. It is recommended that the thesis proposal form be submitted to the dean of The Graduate College by the end of the student's enrollment in 5399A. Failure to submit the thesis proposal in a timely fashion may result in delayed graduation.

Thesis Committee

The thesis committee must be composed of a minimum of three approved graduate faculty members.

Thesis Enrollment and Credit

The completion of a minimum of six hours of thesis enrollment is required. For a student's initial thesis course enrollment, the student will need to register for thesis course number 5399A. After that, the student will enroll in thesis B courses, in each subsequent semester until the thesis is defended with the department and approved by The Graduate College. Preliminary discussions regarding the selection of a topic and assignment to a research supervisor will not require enrollment for the thesis course.

Students must be enrolled in thesis credits if they are receiving supervision and/or are using university resources related to their thesis work. The number of thesis credit hours students enroll in must reflect the amount of work being done on the thesis that semester. It is the responsibility of the committee chair to ensure that students are making adequate progress toward their degree throughout the thesis process. Failure to register for the thesis course during a term in which supervision is received may result in postponement of graduation. After initial enrollment in 5399A, the student will continue to enroll in a thesis B course as long as it takes to complete the thesis. Thesis projects are by definition original and individualized projects. As such, depending on the topic, methodology, and other factors, some projects may take longer than others to complete. If the thesis requires work beyond the minimum number of thesis credits needed for the degree, the student may enroll in additional thesis credits at the committee chair's discretion. In the rare case when a student has not previously enrolled in thesis and plans to work on and complete the thesis in one term, the student will enroll in both 5399A and 5399B.

The only grades assigned for thesis courses are PR (progress), CR (credit), W (withdrew), and F (failing). If acceptable progress is not being made in a thesis course, the instructor may issue a grade of F. If the student is making acceptable progress, a grade of PR is assigned until the thesis is completed. The minimum number of hours of thesis credit ("CR") will be awarded only after the thesis has been both approved by The Graduate College and released to Alkek Library.

A student who has selected the thesis option must be registered for the thesis course during the term or Summer I (during the summer, the thesis course runs ten weeks for both sessions) in which the degree will be conferred.

Thesis Deadlines and Approval Process

Thesis deadlines are posted on The Graduate College (http://www.gradcollege.txstate.edu/) website under "Current Students." The completed thesis must be submitted to the chair of the thesis committee on or before the deadlines listed on The Graduate College website.

The following must be submitted to The Graduate College by the thesis deadline listed on The Graduate College website:

1. The Thesis Submission Approval Form bearing original (wet) and/or electronic signatures of the student and all committee members.
2. One (1) PDF of the thesis in final form, approved by all committee members, uploaded in the online Vireo submission system.

After the dean of The Graduate College approves the thesis, Alkek Library will harvest the document from the Vireo submission system for publishing in the Digital Collections database (according to the student's embargo selection). **NOTE: MFA Creative Writing theses will have a permanent embargo and will never be published to Digital Collections.**

While original (wet) signatures are preferred, there may be situations as determined by the chair of the committee in which obtaining original signatures is inefficient or has the potential to delay the student's

progress. In those situations, the following methods of signing are acceptable:

- signing and faxing the form
- signing, scanning, and emailing the form
- notifying the department in an email from their university's or institution's email account that the committee chair can sign the form on their behalf
- electronically signing the form using the university's licensed signature platform.

If this process results in more than one document with signatures, all documents need to be submitted to The Graduate College together.

No copies are required to be submitted to Alkek Library. However, the library will bind copies submitted that the student wants bound for personal use. Personal copies are not required to be printed on archival quality paper. The student will take the personal copies to Alkek Library and pay the binding fee for personal copies.

Master's level courses in Computer Science: CS

Courses Offered
Computer Science (CS)

CS 5100. Advanced Computer Science Internship.
This course provides advanced training supervised by computer scientists in internship programs approved by the department. Course cannot be counted toward any graduate degree, is open only to majors in the Department of Computer Science. May be repeated once. This course does not earn graduate degree credit. Prerequisite: Instructor approval.
1 Credit Hour. 0 Lecture Contact Hours. 20 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

CS 5199B. Thesis.
This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

CS 5299B. Thesis.
This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding.
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

CS 5300. Professional Development of Graduate Assistants.
This course is designed to develop and enhance the professional and technical skills of graduate teaching and instructional assistants. Topics covered may include, but are not limited to, teaching skills, technical skills, ethical and legal issues, and laboratory management. This course does not earn graduate degree credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

CS 5301. Programming Practicum.
This course provides an intensive review of programming through data structures. Topics include syntax, semantics, problem-solving, and algorithm development. Credit for this course cannot be applied to a graduate degree.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from Graduate GPA|Leveling
Grade Mode: Leveling/Assistantships

CS 5302. Foundations of Data Structures and Algorithm Design.
This course serves as a foundation course for computer science master's degree students who need reinforcement of fundamental concepts covered by CS 3358. This course does not earn graduate degree credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

CS 5303. Foundations of Computer Architecture.
This foundation course for CS master's degree students who need CS 3339 concept reinforcement covers fundamental hardware components. Topics include ALUs, single and multiple cycle datapath and control, RISC vs. CISC, pipelining, caches, I/O, virtual memory, and related performance issues. It may be repeated once and is non-graduate degree credit. Prerequisite: Instructor Approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

CS 5305. Foundations of Operating Systems.
This course serves as a foundation course for computer science master's students who need reinforcement of fundamental concepts covered by CS 4328. Topics include the principles of operating systems, central processing unit scheduling algorithms, memory management, cooperating sequential processes, and device management. Credit for this course cannot be applied to a graduate degree.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

CS 5306. Advanced Operating Systems.
This course provides a study of modern operating systems, including network, distributed, and real-time systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5310. Network and Communication Systems.
This course provides a study of network and communication systems. Students will be required to perform verification and implementation of protocols.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5315. Responsible and Trustworthy AI.
This course explores the foundational principles and practices that define responsible and trustworthy Artificial Intelligence (AI), introducing AI Engineering and Engineering for Trustworthy AI with a focus on designing and deploying effective, ethical, and trustworthy systems. Students will examine critical concepts such as robustness, explainability, privacy, fairness, bias, and the responsible use of generative AI models and machine learning in production. Each module provides insights into the benefits and limitations of these concepts and their integration into AI development. The course also addresses recent advancements and ethical challenges within the AI domain. Prerequisite: CS 5369L with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5316. Data Mining.
This course covers fundamental concepts and techniques, plus recent developments in data mining and information retrieval. It provides relevant research training and practice opportunities. May not be taken for credit if the student has received credit for CS 4315.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5318. Principles of Programming Languages.
This course focuses on the principles of programming languages. Topics covered include programming paradigms, concepts of programming languages, formal syntax and semantics, and language implementation issues.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5325. Reinforcement Learning.
This course offers an introduction to Reinforcement Learning (RL), covering fundamental concepts like Markov Decision Processes (MDPs), Q-learning, and policy gradients, and progressing to advanced methods such as Deep Reinforcement Learning (DRL) and Proximal Policy Optimization (PPO). Students will apply RL algorithms in hands-on projects using Python, OpenAI Gym, and PyTorch, with real-world applications in robotics, game AI, and autonomous systems. By the end of the course, students will have the theoretical and practical skills needed to design, implement, and evaluate RL agents for complex decision-making tasks. Prerequisite: CS 5369L with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5326. Advanced Studies in Human Factors of Computer Science.
This course provides a professional-level presentation of techniques and research findings related to human-computer interactions.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5329. Algorithm Design and Analysis.
This course provides an introduction to algorithm design and analysis, computational complexity, and NP-completeness theory.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5331. Crafting Compilers.
Overview of the internal structure of modern compilers. Research on compilation techniques. Topics include lexical scanning, parsing techniques, static type checking, code generation, dataflow analysis, storage management, and execution environments.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5332. Data Base Theory and Design.
This course covers computer system organization for the management of data. Topics include data models, data model theory, optimization and normalization, integrity constraints, query languages, and intelligent database systems.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5334. Advanced Internet Information Processing.
This course integrates popular scripting and database programming languages to provide advanced information processing for Internet applications that demand database support and sophisticated, application-specific information processing.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5338. Formal Languages.
This course covers advanced topics in automata theory, grammars, Turing machines, decidability, and algorithmic complexity. A strong background in both data structures and discrete mathematics is required.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5341. Advanced Network Programming.
Study of advanced concepts and programming skills in computer networks such as advanced TCP/IP, API, multicasting and broadcasting, reliable communications, advanced I/O functions and options. Prerequisite: CS 5310 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5342. Robotics and Autonomous Systems.
This course covers robot programming and the implementation of basic algorithms and techniques for robotics and autonomous systems. Topics include motion control, state estimation and tracking with Kalman filters, localization with particle filters, computer vision, object detection, task and motion planning, deep reinforcement learning, multirobot systems, applications such as autonomous vehicles, and social implications of intelligent robots. This course emphasizes the implementation of robotic systems for real-world applications. Prerequisite: CS 5329 with grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5343. Wireless Communications and Networks.
This course covers the fundamental aspects of wireless communications and wireless/mobile networks, introduction of wireless/mobile networking Application Programming Interfaces (APIs).
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5346. Advanced Artificial Intelligence.
This course covers knowledge representation, knowledge engineering, parallel and distributed artificial intelligence (AI), heuristic searches, machine learning and intelligent databases, and implementation of systems in high-level AI languages.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5351. Parallel Processing.
This course provides an introduction to the design and analysis of parallel algorithms, parallel architectures, and computers.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5352. Distributed Computing.
This course provides studies in advanced topics in distributed systems: concurrency control and failure recovery, management of replicated data, distributed consensus and fault tolerance, remote procedure calls, naming, and security.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5361. Generative Artificial Intelligence.
This course introduces Generative Artificial Intelligence (Generative AI), focusing on key models like Autoencoders, Variational Autoencoders (VAEs), and Generative Adversarial Networks (GANs), along with advanced text and audio generation models. Emphasizing hands-on learning, students will implement these models in practical assignments and projects. The course covers applications in creative AI, data augmentation, and synthetic data generation, while also addressing ethical considerations such as bias, deepfakes, and intellectual property. Students will develop the skills to apply generative models in a variety of real-world contexts. Prerequisite: CS 5369L with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5369J. Advanced Human Computer Interaction.
This course will cover state of the art human computer interaction topics such as perceptual compression, eye-gaze, and brain computer interfaces with emphasis on the human visual system, eye-tracking, and electroencephalography.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

CS 5369L. Machine Learning and Applications.
Provides broad introduction to machine learning, including learning theory, and recent topics like support vector machines and feature selection. Covers basic ideas, intuition, and understanding behind modern machine learning methods. Discusses applications like face recognition, text recognition, biometrics, bioinformatics, and multimedia retrieval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

CS 5369Q. Recommender Systems.
This course covers various concepts of recommender systems, including personalization algorithms, evaluation tools, and user experiences. Discussion of how recommender systems are deployed in business applications, design of new recommender experiences, and how to conduct and evaluate research in recommender systems. Cannot take for credit if already took CS 4379Q.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

CS 5369Y. Green Computing.
Reducing mobile device, cloud computing platform, and supercomputer energy consumption is a paramount, daunting problem. This course covers state-of-the-art green computing research, including energy-efficient hardware and software design, power-aware resource management and storage solutions, green data centers and mobile computing. Cannot be taken for credit if received CS 4379Y credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

CS 5369Z. Distributed Ledger Systems and Blockchains: Theory and Applications.
This course covers fundamental concepts underlying the design, implementation, research, and applications of Distributed Ledger Technology (DLT) systems (e.g., blockchains). It introduces implementations, applications, and performance evaluation of DLT systems. Additionally, through homework projects, the students will be introduced to current research on DLT systems and perform independent study and small-scale research on selected topics. Course topics include cryptography encryption, security, anonymity, cryptographic data structures, DLT performance evaluation, DLT applications, and current DLT research.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

CS 5375. Multimedia Computing.
This course provides a study of the digital representation and processing of the three principal multimedia data types: image, audio, and video. Standards, storage media, and compression techniques for the three data types are covered.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5378. Advanced Computer Security.
This course covers various aspects of producing secure computer information systems that provide guaranteed controlled sharing. Emphasis is on software models and design, including discovery and prevention of computing systems security vulnerabilities. Current systems and methods are examined and critiqued.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5388. Advanced Computer Graphics.
This course covers the algorithms and data structures used in representing and processing visual data.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5389. Graphical User Interfaces.
This course covers both abstract and practical treatments of using graphics to implement interactive computer/human interfaces. It includes a survey of the major GUI standards and tools.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5391. Survey of Software Engineering.
The course covers the software life cycle, emphasizing system analysis and design, including a survey of methodologies based on data flows and objects. The course includes a professional ethics component.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5392. Formal Methods in Software Engineering.
The use of design and specification languages in producing software systems. Emphasis is placed on proving correctness of designs and implementations.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5393. Software Quality.
The latter half of the software life cycle is discussed. Topics include testing, performance evaluation, and software metrics. Appropriate software tools are studied and used.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5394. Advanced Software Engineering Project.
Students produce a software project of significant size in a team environment. All aspects of the software engineering course sequence are integrated and put into practice.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5395. Independent Study in Advanced Computer Science.
Open to graduate students on an independent basis by arrangement with the faculty member concerned. Course is not repeatable for credit. Prerequisite: CS 3358 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

CS 5396. Advanced Software Engineering Processes and Methods.
The essentials of software engineering processes, methods, and tools for the evolutionary design of complex interactive software are discussed. Overviews of other topics like quality concepts, SEI CMM, information technology, and network technology are covered. Student completes a literature survey of the latest software engineering analysis and design processes, methods, and tools.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CS 5399A. Thesis.
This course represents a student's initial thesis enrollment. No thesis
credit is awarded until the student has completed the thesis in CS 5399B.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

CS 5399B. Thesis.
This course represents a student's continuing thesis enrollment. The
student continues to enroll in this course until the thesis is submitted for
binding.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

CS 5599B. Thesis.
This course represents a student's continuing thesis enrollments. The
student continues to enroll in this course until the thesis is submitted for
binding.
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

CS 5999B. Thesis.
This course represents a student's continuing thesis enrollments. The
student continues to enroll in this course until the thesis is submitted for
binding.
9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit