

# MASTER OF SCIENCE (M.S.) MAJOR IN COMPUTER SCIENCE (DATA SCIENCE CONCENTRATION)

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 webpage (<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
- official transcripts from **each institution** where course credit was granted
- minimum 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

### TOEFL or IELTS Scores

Non-native English speakers who do not qualify for an English proficiency waiver:

- official TOEFL iBT scores required with a 78 overall
- official IELTS (academic) scores required with a 6.5 overall and
  - minimum individual module scores of 6.0

The student may qualify for English-based conditional admission if the minimum scores below are met:

- official TOEFL iBT scores required with a 59 overall
- official IELTS (academic) scores required with a 5.5 overall and
  - minimum individual module scores of 5.5

### 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 36 semester credit hours.

### 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
<b>Computer Science</b> <sup>1</sup>		
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	3
CS 4318	Compiler Construction	3
or CS 4328	Operating Systems	
Advanced computer science electives (3000-4000 level)		6
<b>Mathematics</b> <sup>2</sup>		
MATH 5358	Applied Discrete Mathematics	3
Calculus		8

<sup>1</sup> These courses must be completed with no grade less than "C" and no more than two "Cs."

<sup>2</sup> These courses must be completed with no grade less than "C."

## Course Requirements

Code	Title	Hours
<b>Required Courses</b>		
CS 5329	Algorithm Design and Analysis	3
CS 5346	Advanced Artificial Intelligence	3
CS 5332	Data Base Theory and Design	3
CS 5318	Design of Programming Languages	3
or CS 5338	Formal Languages	
or CS 5351	Parallel Processing	
<b>Concentration</b>		
CS 7312	Advanced Data Mining	3
CS 7313	Advanced Machine Learning and Pattern Recognition	3
CS 7311	Data-Driven Computational Methods and Infrastructure	3
<b>Electives</b>		
Choose 15 hours of advisor-approved electives		15
Total Hours		36

## Comprehensive Examination Requirements

All candidates for graduate degrees must pass one or more comprehensive examinations.

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. 1 Lab Contact Hour.**

**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.

Intensive review of programming through data structures. Includes syntax, semantics, problem solving, algorithm development, and in-class exercises. May be repeated once. This course does not earn 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|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. May be repeated once. This course does not earn 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 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 foundation course is for CS master's students who need CS 4328 fundamental concept reinforcement. It covers the principles of operating systems, algorithms for CPU scheduling, memory management, cooperating sequential processes and device management. It may be repeated once. This course does not earn 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 5306. Advanced Operating Systems.

A study of modern operating systems including network, distributed, or real-time systems. Prerequisites: CS 3358 and CS 4328 both with grades of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5310. Network and Communication Systems.**

A study of network and communication systems. Verification and/or implementation of protocols will be required. Prerequisite: CS 3358 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 student received credit for CS 4315. Prerequisite: CS 3358 with a grade of "C" or better.

**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. Prerequisite: CS 3358 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.**

Professional level presentation of techniques and research findings related to human-computer interactions. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5329. Algorithm Design and Analysis.**

Introduction to algorithm design and analysis, computational complexity, NP – completeness theory. Prerequisites: CS 3358 and MATH 2472 and [MATH 3398 or MATH 5358] all with grades of "C" or better.

**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. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5332. Data Base Theory and Design.**

Computer system organization for the management of data; data models, data model theory, optimization and normalization; integrity constraints; query languages; intelligent database systems. Prerequisites: CS 3358 and CS 4328 both with grades of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5334. Advanced Internet Information Processing.**

Integration of popular scripting languages (Perl, JavaScript, PHP, and other CGI capable languages) and database programming languages (embedded database programming languages, JavaServlets, and PHP) to provide advanced information processing for Internet applications that demand both database support and sophisticated, application specific information processing. Prerequisite: CS 4332 or CS 5332 either with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5335. Research in Object-Oriented System Development.**

The course covers the object-oriented methodologies for system analysis, design, implementation, testing, and other aspects of system development. Emphasis will be on using OO methodologies to manage the complexity of complicated software. Other topics like modeling, OODB, and OO languages will also be covered. Prerequisites: CS 3358 and [CS 4332 or CS 5332] both with grades of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5338. Formal Languages.**

Advanced topics in automata theory, grammars, Turing machines, decidability, and algorithmic complexity. Prerequisites: CS 3358 and MATH 3398 both with grades of "C" or better.

**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 5343. Wireless Communications and Networks.**

Study of the fundamental aspects of wireless communications and wireless/mobile networks, introduction of wireless/mobile networking APIs. Prerequisites: CS 3358 with a grade of "B" or better and 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 5346. Advanced Artificial Intelligence.**

Knowledge representation; knowledge engineering; parallel and distributed AI; heuristic searches; machine learning and intelligent databases; implementation of systems in high-level AI languages. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5351. Parallel Processing.**

Introduction to the design and analysis of parallel algorithms, parallel architectures, and computers. Prerequisites: CS 3358 and CS 4328 both with grades of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5352. Distributed Computing.**

Study of 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.

Prerequisites: CS 3358 and CS 4328 both with grades of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5369B. Computer Vision.**

This course covers the basic and recent topics in computer vision. Topics include classic computer vision features, object tracking and recognition, detection and segmentation, camera models, and image and video retrieval. Prerequisite: CS 3358 with a grade of "C" or better.

**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 5369G. Web Service Engineering.**

Advanced concepts and techniques for enabling Web application integration and interaction using Semantic Web and Web services.

Concepts and techniques include service discovery ontology (RDF, DAML-S), XML-based interactions standards (ebXML, RossettaNet) and Web Services (WSDL, SOAP, UDDI, BPEL). Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**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. Prerequisite: CS 3358 with a grade of "D" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** 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.

Prerequisite: CS 3358 grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Course Attribute(s):** Topics

**Grade Mode:** Standard Letter

**CS 5369M. Software Evolution and Maintenance.**

Software evolution and maintenance is one of the most important and complex activities in software engineering. Programmers rarely build software from scratch but often modify existing software to fix defects or add new features. This course studies the fundamentals of cutting-edge techniques and tools for software evolution and maintenance.

Prerequisite: CS 3358 with a grade of "C" or better.

**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. Prerequisite: CS 3358 with a grade of "C" or better or instructor approval.

**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.

Prerequisite: CS 3358 with a grade of "C" or better.

**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.**

A study of the digital representation and processing of major multimedia data types: image, audio, and video. Compression techniques for the three data types, standards, and storage media. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5376. Enterprise Application Integration.**

Introduction to the integration of all services available on the Web. It emphasizes component-based integration frameworks based on J2EE specification (EJB, Servlets, JMS), inter-organization workflow integration frameworks, and XML framework. Students must have knowledge of object-oriented design, object-oriented programming language, databases, and networking. Prerequisite: CS 3358 with a grade of "C" or better.

**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. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5388. Advanced Computer Graphics.**

A study of the algorithms and data structures used in representing and processing visual data. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5389. Graphical User Interfaces.**

Covers both abstract and practical treatments of using graphics to implement interactive computer/human interfaces. Includes a survey of the major GUI standards and tools. Prerequisite: CS 3358 with a grade of "C" or better.

**3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.**

**Grade Mode:** Standard Letter

**CS 5391. Survey of Software Engineering.**

A study of the software life cycle with emphasis on system analysis and design. Methodologies based on data flows and on objects will be surveyed. A component on professional ethics is included. Prerequisite: CS 3358 with a grade of "C" or better.

**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. Prerequisites: CS 5391 with a grade of "C" or better.

**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. Prerequisite: CS 5391 with a grade of "C" or better.

**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. Prerequisite: CS 5391 with a grade of "C" or better.

**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. Prerequisite: CS 5391 with a grade of "C" or better.

**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