COMPUTER SCIENCE, MS

Degree: Master of Science (MS) **Field of Study:** Computer Science

Program Overview

The MS in Computer Science has three tracks: a Course-Focused track, a Project-Focused track, and a Thesis-Focused track. Although all of the three options require 30 credit hours, they are structured differently to achieve different objectives. The Course-Focused track prepares students for advanced industry employment and should be treated as a terminal MS degree in CS. The Project-Focused track if for students who seek opportunities for completing an applied project, for example within the context of an established collaboration with industry. The Thesis-Focused track is mainly for students who have interests in research. Therefore, the three tracks have different requirements in admission, advising, and course work.

Admission

Graduate students shall be admitted to the MS degree program upon recommendation of the faculty of the CS program. Requirements for admission include a strong record of scholarship in a completed bachelor's degree program in computer science and related areas, and fluency in written and spoken English. The University requires all foreign applicants to show English proficiency by achieving a TOEFL score of at least 90 on the internet-based exam for the thesis-focused or the project-focused track. For the course-focused track, a minimum TOEFL score of 80 is required. For students who are expected to have any professional student to student interaction, e.g., as a teaching assistant, a lab instructor, or a tutor, a minimum TOEFL score of 90 is required. It is required that all students submit original copies of GRE scores, with the exception of CWRU students applying to the Combined Bachelor's/ Master's Program.

The MS program requires students to have substantial knowledge of undergraduate computer science material. Applications from students with a bachelor's degree in fields other than computer science may be granted admission on a provisional basis. Students should have knowledge equivalent to that in the courses:

- CSDS 233
- CSDS 310
- Any one course listed as an undergraduate Computer Science Breadth Requirement

Students deficient in one or more of these areas (admission with provision) may be required to satisfy this requirement by taking the corresponding courses listed above. These courses cannot be counted towards their MS requirement. However, a student taking and passing a course that subsumes one of the requirements automatically demonstrates knowledge of the material in the required course; e.g. taking CSDS 410 demonstrates knowledge of the material in CSDS 310. Such graduate level courses will be used to satisfy their MS requirement.

Applicants lacking the required background are encouraged to explore the Computer Science pathway options. Additional information on the Computer Science pathway can be obtained by contacting the department.

Registration

Course registration can be performed through the SIS system. Each semester before registration, students should update any personal information that may have changed by logging onto the SIS and editing the appropriate information. All registration holds must be lifted in order to successfully complete the registration process.

Advising

Each MS student will be assigned an academic advisor, who will assist the student in formulating an academic program. A student in the thesisfocused or project-focused track is expected to pick a research advisor in the program by the end of their first semester. The research (co)advisor must be a faculty member of the university whose status is tenured, tenure-track, non-tenure-track, emeritus, or research faculty. Faculty with other status are not eligible to serve as a student (co)advisor. If the primary affiliation of the research advisor is not with the Computer Science program, the student must have a research co-advisor in Computer Science. The research advisor will supervise the student's thesis or project and also serves as the academic advisor. Each student, in consultation with their advisor(s), must submit a Planned Program of Study preferably before completing 9 credit hours of coursework. This should specify all courses and thesis/project work that will be counted toward the 30 credit hour requirement.

Graduate Policies

For graduate policies and procedures, please review the School of Graduate Studies section of the General Bulletin.

Program Requirements

Pathway and Course-Focused Tracks

The Pathway track requires completion of 34.5 credit hours of approved coursework. The Course-Focused MS degree program requirements consist of the completion of 30 credit hours of approved coursework. Both Pathway and Course-Focused tracks require satisfactory completion of a comprehensive exam, i.e., passing the course ENGR 600 with a grade of "P". ENGR 600 is satisfactorily completed by achieving a grade of B or higher in each one of three courses in the student's depth area.

Project and Thesis Tracks

The Project-Focused track requires 24 credit hours of coursework and 6 credit hours of project CSDS 695.

The Thesis-Focused track requires 18 credit hours of coursework and 12 credit hours of thesis CSDS 651. A BS/MS student is required to choose the thesis-focused track initially.

Both the Thesis-Focused and the Project-Focused track require a formal written report, as well as a final oral examination by a committee of at least three faculty members, two of whom must be primarily affiliated with the CS program. The research advisors and co-advisors are committee members. For Project-Focused track students, the oral examination fulfills the Comprehensive Examination requirement of the School of Graduate Studies.

Track Transfer

If a student wishes to switch from one track to another, the following requirements apply:

• Deadline. In each semester, students must request to switch track one week before the date at which Drop/Add ends, as stated in the academic calendar.

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- Pathway, Course-only, or Project to Thesis. A course-only student may request to switch to the Thesis track only if they (1) have already taken at least 9 credit hours of letter graded CSDS courses and (2) has a GPA of 3.5 or higher and (3) has a TOEFL score of 90 or higher and (4) has the recommendation of a CDS advisor or (co)advisor.
- Pathway or Course-only to Project. A Pathway or Course-only student may request to switch to the project track only if they (1) have a TOEFL score of 90 or higher and (2) has the recommendation of a CDS advisor or (co)advisor.
- Thesis to Project, or Thesis or Project to Course-only. Such a transfer needs approval from the student's advisor and the department chair.
- Petition. If a student fails to satisfy the transfer requirements, a
 petition may be submitted by a CDS advisor or (co)advisor to the
 department chair. In no case may petitions be submitted by non-CDS
 faculty members or by students.

Students should consult with their academic advisor and/or department to determine the detailed requirements within this framework.

Course Requirements

For all four tracks, at least 18 credit hours of coursework must be at the 400-level or above.

Students in the Pathway track are required to take CSDS 410 in their first semester, and to pass

- By the end of the second semester, CSDS 401
- By the end of the first academic year or before 18 credit hours of coursework
 - CSDS 410
 - Any one course that is either listed as an undergraduate Computer Science Breadth Requirement or subsumes a computer science breadth course

Students failing the conditions above will be separated from further study in Computer Science. CSDS 401 cannot be counted toward the Coursefocused, Project, or Thesis tracks.

All students are required to have specialized knowledge in at least one of the following depth areas, by taking at least three graduate-level classes from that area. The list of acceptable classes is shown below. For Research or Project-focused tracks, the chosen area should correspond to the student's thesis research area or project in general. CSDS 600 classes will also qualify in this category with approval from the student's CDS advisor. The remaining classes can be (i) any other class from the classes listed below, or (ii) any letter graded CSDS class (see note below), or (iii) at most two graduate-level classes other than those in category (i) and (ii) (such as non-letter-graded graduate CSDS classes or graduate classes in other departments).

(Note: The School of Graduate Studies and the Case School of Engineering limit the number of undergraduate courses that can be taken for credit by Master's students.)

Students should discuss their courses with their advisor every semester prior to registration. Students must achieve a grade point average of 3.0 or higher; it is computed for all of the letter-graded courses on the student's academic program.

Depth areas:		
Code	Title	Credit Hours
Algorithms & The	ory Courses:	
CSDS 410	Analysis of Algorithms	3
CSDS 440	Machine Learning	3
CSDS 455	Applied Graph Theory	3
CSDS 456	Data Privacy	3
CSDS 477	Advanced Algorithms	3
MATH 408	Introduction to Cryptology	3
Artificial Intelliger	nce Courses:	
CSDS 440	Machine Learning	3
CSDS 442	Causal Learning from Data	3
CSDS 443	Algorithmic Fairness	3
CSDS 446	Machine Learning on Graphs	3
CSDS 451	Designing High Performant Systems for AI	3
CSDS 455	Applied Graph Theory	3
CSDS 465	Computer Vision	3
CSDS 491	Artificial Intelligence: Probabilistic Graphical Models	3
CSDS 496	Artificial Intelligence: Sequential Decision Makin	g 3
CSDS 497	Artificial Intelligence: Statistical Natural Language Processing	ge 3
CSDS 499	Algorithmic Robotics	3
ECSE 484	Computational Intelligence I: Basic Principles	3
Bioinformatics Co	ourses:	
CSDS 410	Analysis of Algorithms	3
CSDS 435	Data Mining	3
CSDS 440	Machine Learning	3
CSDS 446	Machine Learning on Graphs	3
CSDS 456	Data Privacy	3
CSDS 458	Introduction to Bioinformatics	3
CSDS 459	Bioinformatics for Systems Biology	3
SYBB 412	Survey of Bioinformatics: Programming for Bioinformatics	3
Computer Networ	ks & Systems Courses:	
CSDS 425	Computer Networks I	3
CSDS 427	Internet Security and Privacy	3
CSDS 428	Computer Communications Networks II	3
CSDS 438	High Performance Data and Computing	3
CSDS 444	Computer Security	3
CSDS 451	Designing High Performant Systems for Al	3
ECSE 414	Wireless Communications	3
Databases & Data	Mining Courses:	
CSDS 413	Introduction to Data Analysis	3
CSDS 433	Database Systems	3
CSDS 435	Data Mining	3
CSDS 440	Machine Learning	3
CSDS 446	Machine Learning on Graphs	3
CSDS 459	Bioinformatics for Systems Biology	3
PQHS 471	Machine Learning & Data Mining	3
STAT 426	Multivariate Analysis and Data Mining	3

Security & Privacy Courses:

CSDS 427	Internet Security and Privacy	3
CSDS 444	Computer Security	3
CSDS 428	Computer Communications Networks II	3
CSDS 456	Data Privacy	3
CSDS 493	Software Engineering	3
MATH 408	Introduction to Cryptology	3
Software Engineering Courses:		
CSDS 425	Computer Networks I	3
CSDS 433	Database Systems	3
CSDS 438	High Performance Data and Computing	3
CSDS 442	Causal Learning from Data	3
CSDS 444	Computer Security	3
CSDS 448	Smartphone Security	3
CSDS 493	Software Engineering	3