COMPUTER & INFORMATION SCIENCE, MSE

The CIS/ MSE program offers scholars the opportunity for advanced study in the scientific foundations of the rapidly growing field of computer science. Applicants to the MSE program should have strong undergraduate training in mathematics and computer science; prior coursework should include such areas as operating systems, programming languages, data structures, discrete mathematics, linear algebra, algorithms and theory; coursework should be similar to the courses taken by computer science undergraduates at the University of Pennsylvania.

Candidates who do not have an undergraduate major in computer science should consider applying to the Master of Computer and Information Technology program (MCIT). Dual degree/transfer information for current students can be accessed here. Submatriculation information for current students can be accessed here.
CIS/MSE students can pursue many areas within their curriculum, including AI, databases, security, programming languages, etc. The CIS Graduate Program prepares our students to be tomorrow's innovators, leaders, and visionaries. Our MSE graduates have obtained a wide range of positions in industry and continued in doctoral studies. Here's a sample:

- Senior Programmer/Analyst, Computational Biology & Informatics Laboratory, University of Pennsylvania
- Software Development Engineer, Microsoft
- Researcher, Lincoln Laboratory, MIT
- Systems Engineer, Lockheed Martin
- Researcher, School of Medicine/Radiology, University of Pennsylvania
- Doctoral Student, Computer & Information Science, University of Pennsylvania
- Doctoral Student, Computer Science, Brown University,
- Doctoral Student, Computer Science, University of Illinois, Urbana-Champaign

A more extensive list can be found here.

For more information: http://www.cis.upenn.edu/prospective-students/graduate/mse.php

Curriculum

The MSE degree requires completion of ten course units that satisfy all of the following requirements:

Code	Title	Course Units
CIS Courses		
At least seven of the ten course units required for the degree must be CIS courses. These seven courses include four core courses and three CIS elective courses described below.		
Core Courses		
Select four courses from the following:		4
Theory Courses		
CIS 5020	Analysis of Algorithms	
CIS 5110	Theory of Computation	
Systems Courses		
CIS 5050	Software Systems	
CIS 5480	Operating Systems Design and Implementation	
CIS 5530	Networked Systems	
CIS 5550	Internet and Web Systems	
Machine-Learning Courses		
CIS 5200	Machine Learning	
CIS 5190	Applied Machine Learning	
CIS 5210	Artificial Intelligence	
Other Courses		
CIS 5000	Software Foundations	
CIS 5710	Computer Organization and Design	
The four core courses must include 1) at least one systems course, or CIS 5010; 2) at least one theory course; and 3) at most one machine-learning course. (the other machine-learning courses can still be taken as electives.)		
CIS Elective Courses		
Any CIS courses numbered from CIS 5000 to CIS 7000		3
At most one CIS 7000 class can be included		
CIS or Non-CIS Elective Courses		
Each of the three remaining courses must be a CIS course (numbered from CIS 5000 to CIS 8000) or a course from the list of approved non-CIS courses		3
Total Course Units		**10**

Advanced study in a specific area of computer science is encouraged. Besides coursework, students may pursue Independent Studies to increase their depth of knowledge in a specific area - a maximum of two independent study credits can be used as electives for the CIS/MSE degree. Students are also encouraged to submit a master's thesis (see below) which may count as two course units of Masters Student Thesis Research, CIS 9990.

FORMS: Click ***here*** to access SEAS graduate forms, including the Graduate Petition for Action; click ***here*** to access CIS graduate forms.

Master's Thesis

A student wishing to complete a master's thesis may enroll in two course units of CIS 9990/Masters Thesis Research, which count as electives towards the ten credits needed for the CIS/MSE degree. The student first chooses a thesis advisor, who must belong to the CIS Graduate Group, proposing a suitable thesis topic. The thesis advisor and student discuss and determine the topic, scope, etc. of the thesis. The advisor and student also determine one other faculty member to be a reader for the thesis. Once the advisor, reader, and topic have been chosen, the student should email Redian Furxhiu (redian@seas.upenn.edu) who will provide a google doc master's thesis approval form which can be shared with the thesis advisor, reader, and CIS/MSE , for approval. The advisor and reader will evaluate the thesis and make the determination of its suitability as a research document. An oral presentation of the thesis is required. This can take the form of a public presentation open to all CIS faculty and students to attend, or in lieu of that, a conference presentation or poster presentation (decided by the thesis adviser). Once the final thesis document is approved, it is signed by the advisor, reader, and CIS/MSE Program Chair, Dr. Swapneel Sheth (swapneel@cis.upenn.edu). Information re: thesis formatting and submission of the thesis to the SEAS Research and Academic Services Office can be accessed

here. (http://www.cis.upenn.edu/current-students/graduate/advising/graduation.php) A copy of the approved version of the thesis should be emailed to the CIS Master's chair.

Cumulative GPA Requirement

- A minimum GPA of 2.7 for master's students must be maintained in order to be considered in good academic standing.
- If this minimum is not maintained, academic probation or dismissal from the program will be invoked.
- A 2.7 final GPA must be achieved to graduate in all situations. (Effective Fall 2007 class). Students are permitted to graduate with an F grade in a course; however, no grade lower than a C- will be counted towards the degree.
- In particular, a C- grade or better must be achieved in the core courses or they must be retaken.

Graduation Checklist for MSE Students

- Watch for email announcements regarding applying for graduation. Information on applying for a degree/graduation can be found here (http://www.cis.upenn.edu/current-students/graduate/advising/graduation.php).
- If needed, master's thesis instructions should be obtained early on in the writing stage. You should make your advisor aware of the need for a timely reading and signature before graduation.
- Check that your academic record is cleared of *Incompletes*, *No Grade Reported*, and *Unsatisfactory Progress*. and that your GPA meets the requirements..
- Students who graduate in August or December may participate in the following May Commencement; a student graduating in August may participate in the May Commencement prior to graduation - contact Redian Furxhiu (redian@seas.upenn.edu)for information.
- Make sure that your bursar's bill is cleared before the end of the final semester.
- Students are allowed a maximum of seven years to complete the MSE degree program.

Optional Concentrations

Artificial Intelligence

Code	Title	Course Units
Artificial Intelligence Concentration Requirements		
Select any four CUs from the list below:		4
CIS 5190	Applied Machine Learning	1
or CIS 5200	Machine Learning	
CIS 5210	Artificial Intelligence	1
CIS 5220	Deep Learning for Data Science	1
CIS 5230	Ethical Algorithm Design	1
CIS 5300	Natural Language Processing	1
CIS 5800	Machine Perception	1
CIS 5810	Computer Vision & Computational Photography	1
CIS 6200	Advanced Topics in Machine Learning	1
CIS 6250	Theory of Machine Learning	1
CIS 6300	Advanced Topics in Natural Language Processing	1
ESE 5460	Principles of Deep Learning	1
MEAM 5100	Design of Mechatronic Systems	1
MEAM 5200	Introduction to Robotics	1

Computer Vision

Code	Title	Course Units
Computer Vision Concentration Requirements		
CIS 5200	Machine Learning	1
CIS 5800	Machine Perception	1
CIS 5810	Computer Vision & Computational Photography	1
CIS 6800	Advanced Topics in Machine Perception	1
Total Course Units		**4**

Software Foundations

Code	Title	Course Units
Software Foundations Concentration Requirements		
Select any four CUs from the list below:		4
CIS 5000	Software Foundations	1
CIS 5400	Principles of Embedded Computation	1
CIS 5470	Software Analysis	1
CIS 5520	Advanced Programming	1
CIS 5730	Software Engineering	1
CIS 6700	Advanced Topics in Programming Languages	1
CIS 6730	Computer-Aided Verification	1
CIS 6820	Friendly Logics	1

Systems

Code	Title	Course Units
Systems Concentration Requirements		
Select any four CUs from the list below:		4
CIS 5050	Software Systems	1
CIS 5410	Embedded Software for Life-Critical Applications	1
CIS 5480	Operating Systems Design and Implementation	1
CIS 5490	Wireless Communications for Mobile Networks and Internet of Things	1
CIS 5500	Database and Information Systems	1
CIS 5510	Computer and Network Security	1
CIS 5530	Networked Systems	1
CIS 5550	Internet and Web Systems	1
CIS 6500	Advanced Topics in Databases	1

Theoretical Foundations

Code	Title	Course Units
Theoretical Foundations Concentration Requirements		
Select any four CUs from the list below:		4
CIS 5020	Analysis of Algorithms	
CIS 5110	Theory of Computation	

CIS 5150	Fundamentals of Linear Algebra and Optimization
CIS 5230	Ethical Algorithm Design
CIS 5560	Cryptography
CIS 6250	Theory of Machine Learning
CIS 6700	Advanced Topics in Programming Languages
CIS 6820	Friendly Logics

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2025 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.