MATHEMATICS AND COMPUTER SCIENCE (BA)

Department Website (http://cs.nyu.edu/)

NYSED: 27024 **HEGIS:** 1799.00 **CIP:** 11.0101

Program Description

The joint major in Mathematics and Computer Science is an interdisciplinary program of study offered by the Departments of Mathematics and Computer Science at the renowned Courant Institute of Mathematical Sciences, an independent division of New York University. The Courant Institute is one of the top-ranked mathematics departments worldwide and is well-known for its pioneering history in the field of applied mathematics. This major offers the opportunity for deep study of the field of computer science alongside such relevant mathematical fields as analysis, algebra, probability, statistics, combinatorics, and numerical analysis.

Honors Program in Computer Science and Mathematics

The prerequisite for declaring this major is completion of either CSCI-UA 101 Intro to Computer Science or CSCI-UA 102 Data Structures (depending on placement) with a C or better. This is a twenty-course (80-credit) interdisciplinary major offered by the Departments of Computer Science and Mathematics.

The honors degree will be awarded to students with outstanding performance in the program. To be eligible for this distinction students must:

1. Complete all college BA requirements including at least 64 credits of graded work in the College of Arts and Science.
2. Complete all of the course requirements for the program.
3. Maintain a grade point average of 3.65 or better in the major sequence (including honors requirements) AND maintain a general grade point average of 3.65 or better.
4. Request admission to the honors program by completing the Honors Admission Request Form.
5. Meet with the computer science program administrator and director of undergraduate studies to discuss the program requirements once they have been admitted.
6. Students are required to submit a copy of their completed thesis to the mathematics honors faculty adviser as well as to the faculty director of undergraduate studies in computer science. See the Honors Research Project section below for more information.

Course	Title	Credits
Required Honors Courses		
Computer Science Requirements		
CSCI-UA 101	Intro to Computer Science	4
CSCI-UA 102	Data Structures	4
CSCI-UA 201	Computer Systems Org	4
CSCI-UA 202	Operating Systems	4
CSCI-UA 310	Basic Algorithms	4
CSCI-UA 421	Numerical Computing	4
CSCI-UA 453	Theory of Computation	4
Select three computer science courses listed at the CSCI-UA 400 level		12
Mathematics Requirements		
MATH-UA 121	Calculus I	4
MATH-UA 122	Calculus II	4
MATH-UA 123	Calculus III	4
or MATH-UA 129	Honors Calculus III	
MATH-UA 140	Linear Algebra	4
or MATH-UA 148	Honors Linear Algebra	
MATH-UA 325	Analysis	4
or MATH-UA 328	Honors Analysis I	
MATH-UA 329	Honors Analysis II	4
MATH-UA 343	Algebra	4
or MATH-UA 348	Honors Algebra I	
MATH-UA 349	Honors Algebra II	4
Select two of the following:		8
MATH-UA 268	Honors Ordinary Differential Equations	
MATH-UA 338	Honors Theory of Probability	
MATH-UA 358	Honors Numerical Analysis	
MATH-UA 393	Honors I	
MATH-UA 394	Senior Honors II	
MATH-UA 397	Honors III	
MATH-UA 398	Honors IV	
Total Credits		**80**

Where applicable, the same course counts toward both the advanced electives requirement of the regular major and the honors electives. Students who have taken MATH-UA 325 Analysis or MATH-UA 343 Algebra may not take the corresponding MATH-UA 328 Honors Analysis I or MATH-UA 348 Honors Algebra I to fulfill this requirement.

Honors Research Project

Students may complete the honors research project requirement at either department. A research project completed at the math department will be cross-honored by the computer science department and vice versa. That being said, once a student commits to completing a research project at one department, they must satisfy the research requirements and abide by the policies of that department.

To satisfy the research project requirement at the math department, students have two options:

1. To participate in the mathematics Summer Undergraduate Research Experience (https://math.nyu.edu/dynamic/undergrad/ba-cas/activities-research/summer-undergraduate-research-experience/) (SURE) program under faculty supervision. Students who participate in this program are expected to dedicate 30+ hours of research per week over a 10-12 week period during the summer break. Upon concluding their research, students are required to submit an abstract and present their research at Courant's undergraduate research forum in the fall semester of their senior year. This is a competitive program with only a select number of spots. Students who are selected to participate will receive financial support for the summer.

- Honors students interested in the SURE route must apply at the beginning of the spring semester of their junior year.

2. Alternatively, students must complete two (2) semesters of research independent study (MATH-UA 0997, 0998 (https://math.nyu.edu/dynamic/undergrad/ba-cas/independent-study/)) under faculty supervision. Students are expected to dedicate 10-20 hours per week toward their research. Students must receive approval of their honors project from the honors faculty adviser, Professor Chao Li. At the conclusion of the second research independent study, students are required to submit a 15-20 page final report, with the approval of their faculty mentor, and are encouraged to present their research at the Dean's Undergraduate Research Conference (DURC) in the spring semester of their senior year.
   - All joint Math/CS honors majors who are not selected for SURE must satisfy the research project requirement via the independent study route.

Admissions

New York University's Office of Undergraduate Admissions supports the application process for all undergraduate programs at NYU. For additional information about undergraduate admissions, including application requirements, see How to Apply (https://www.nyu.edu/admissions/undergraduate-admissions/how-to-apply.html).

Program Requirements

The prerequisite for declaring the joint major in Mathematics and Computer Science is completion of either CSCI-UA 101 Intro to Computer Science or CSCI-UA 102 Data Structures (depending on placement) with a C or better. This major requires eighteen 4-credit courses (72 credits) completed with a grade of C or better and comprising ten 4-credit MATH-UA courses (40 credits) and eight 4-credit CSCI-UA courses (32 credits) as outlined below.

Course	Title	Credits
General Education Requirements		
First-Year Seminar		4
EXPOS-UA 1	Writing as Inquiry	4
Foreign Language [1]		16
Physical Science		4
Life Science		4
Texts and Ideas		4
Cultures and Contexts		4
Societies and the Social Sciences		4
Expressive Culture		4
Major Requirements		
Foundational Mathematics Requirements [2]		
MATH-UA 120	Discrete Mathematics	4
MATH-UA 121	Calculus I [2]	4
or MATH-UA 131	Mathematics for Economics I	
MATH-UA 122	Calculus II [2]	4
or MATH-UA 132	Mathematics for Economics II	
MATH-UA 123	Calculus III [2]	4
or MATH-UA 129	Honors Calculus III	
or MATH-UA 133	Mathematics for Economics III	
MATH-UA 140	Linear Algebra	4
or MATH-UA 148	Honors Linear Algebra	
MATH-UA 325	Analysis	4
or MATH-UA 328	Honors Analysis I	
MATH-UA 343	Algebra	4
or MATH-UA 348	Honors Algebra I	
Two (2) advanced Mathematics Electives from the following list:		*8*
MATH-UA 240	Combinatorics	
MATH-UA 248	Theory of Numbers	
MATH-UA 251	Intro to Math Modeling	
MATH-UA 262	Ordinary Diff Equations	
or MATH-UA 268	Honors Ordinary Differential Equations	
MATH-UA 263	Partial Diff Equations	
MATH-UA 264	Chaos & Dynamical Systems	
MATH-UA 329	Honors Analysis II	
MATH-UA 333	Theory of Probability	
or MATH-UA 338	Honors Theory of Probability	
MATH-UA 334	Mathematical Statistics	
MATH-UA 349	Honors Algebra II	
MATH-UA 352	Numerical Analysis [3]	
or MATH-UA 358	Honors Numerical Analysis	
MATH-UA 353	Linear and Nonlinear Optimization	
MATH-UA 375	Topology	
MATH-UA 377	Differential Geometry	
MATH-UA 382	Functions of a Complex Variable	
MATH-UA 393	Honors I	
MATH-UA 394	Senior Honors II	
MATH-UA 397	Honors III	
MATH-UA 398	Honors IV	
One (1) General Mathematics Elective Numbered MATH-UA 120 or Higher [4]		*4*
Computer Science Requirements		
CSCI-UA 2	Introduction to Computer Programming (No Prior Experience) [5]	4
CSCI-UA 101	Intro to Computer Science	4
CSCI-UA 102	Data Structures	4
CSCI-UA 201	Computer Systems Org	4
CSCI-UA 202	Operating Systems	4
CSCI-UA 310	Basic Algorithms	4
CSCI-UA 421	Numerical Computing [3]	4
Computer Science Electives		
Select two computer science electives at the 400 level		8
Other Elective Credits		4
Total Credits		**128**

[1] The foreign language requirement is satisfied upon successful completion through the Intermediate level of a language. This may be accomplished in fewer than 16 credits, but those credits must then be completed as elective credit.

[2] Courses from the Calculus sequence (MATH-UA 121 Calculus I, MATH-UA 122 Calculus II, MATH-UA 123 Calculus III) and Mathematics for Economics sequence (MATH-UA 131 Mathematics for Economics I, MATH-UA 132 Mathematics for Economics II, MATH-UA 133 Mathematics for Economics III) cannot both be applied to the joint major. Students must take Calculus I through III OR Mathematics for Economics I through III. Students cannot mix-and-match, combine, double-count, or register simultaneously for separate courses within the two sequences.

[3] Students who take MATH-UA 352 Numerical Analysis or MATH-UA 358 Honors Numerical Analysis as one of their mathematics electives for this major must contact the director of undergraduate studies in computer science before registering for CSCI-UA 421 Numerical Computing.

[4] The general mathematics elective requirement must be a MATH-UA course numbered 120 or higher. This course CANNOT be substituted by a CSCI-UA, DS-UA, DS-GA, PHYS-UA, etc. course.

[5] This course does not count towards the joint major but is a required prerequisite for CSCI-UA 101 Intro to Computer Science. Students who do not need this prerequisite simply replace it with a general degree elective.

Sample Plan of Study

Course	Title	Credits
1st Semester/Term		
MATH-UA 121 or MATH-UA 131	Calculus I [1] or Mathematics for Economics I	4
MATH-UA 120	Discrete Mathematics	4
CSCI-UA 2	Introduction to Computer Programming (No Prior Experience) [2]	4
First-Year Seminar		4
	Credits	**16**
2nd Semester/Term		
MATH-UA 122 or MATH-UA 132	Calculus II [1] or Mathematics for Economics II	4
MATH-UA 140 or MATH-UA 148	Linear Algebra or Honors Linear Algebra	4
CSCI-UA 101	Intro to Computer Science	4
EXPOS-UA 1	Writing as Inquiry	4
	Credits	**16**
3rd Semester/Term		
MATH-UA 123 or MATH-UA 129	Calculus III [1] or Honors Calculus III	4
CSCI-UA 102	Data Structures	4
Texts and Ideas		4
Foreign Language I		4
	Credits	**16**
4th Semester/Term		
MATH-UA 325 or MATH-UA 328	Analysis or Honors Analysis I	4
CSCI-UA 201	Computer Systems Org	4
Cultures and Contexts		4
Foreign Language II		4
	Credits	**16**
5th Semester/Term		
MATH-UA 343 or MATH-UA 348	Algebra or Honors Algebra I	4
CSCI-UA 202	Operating Systems	4
Foreign Language III		4
Expressive Culture		4
	Credits	**16**
6th Semester/Term		
Advanced Mathematics Elective (1 of 2)		4
CSCI-UA 310	Basic Algorithms	4
Foreign Language IV		4
Societies and the Social Sciences		4
	Credits	**16**
7th Semester/Term		
Advanced Mathematics Elective (2 of 2)		4
CSCI-UA 421	Numerical Computing	4
Computer Science Major Elective (400-Level) (#1 of 2)		4
Physical Science		4
	Credits	**16**
8th Semester/Term		
General Mathematics Elective [3]		4
Computer Science Major Elective (400-Level) (#2 of 2)		4
Life Science		4
Other Elective Credits		4
	Credits	**16**
	Total Credits	**128**

[1] Courses from the Calculus sequence (MATH-UA 121 Calculus I, MATH-UA 122 Calculus II, MATH-UA 123 Calculus III) and Mathematics for Economics sequence (MATH-UA 131 Mathematics for Economics I, MATH-UA 132 Mathematics for Economics II, MATH-UA 133 Mathematics for Economics III) cannot both be applied to the joint major. Students must take Calculus I through III OR Mathematics for Economics I through III. Students cannot mix-and-match, combine, double-count, or register simultaneously for separate courses within the two sequences.

[2] This course does not count towards the joint major but is a required prerequisite for CSCI-UA 101 Intro to Computer Science.

[3] The general mathematics elective requirement for the joint major must be a MATH-UA course. This course CANNOT be substituted by a CSCI-UA, DS-UA, DS-GA, PHYS-UA, etc. course.

Learning Outcomes

Upon completion of program requirements, students are expected to have acquired:

1. Skills in writing computer programs and designing software systems.
2. An understanding of the foundational algorithms and data structures used in computer software.
3. An understanding of what is going on "under the hood" of computer software in terms of the underlying computer architecture and operating systems.
4. Advanced knowledge of some specific areas of computer science and its applications.
5. Proficiency in the foundations of modern mathematics, including discrete mathematics, calculus, analysis, and algebra.
6. The ability to communicate mathematically, including understanding, developing, and critiquing mathematical arguments and rigorous proofs.
7. The ability to apply mathematical ideas and methods to questions and problems both within and outside of the mathematical sciences.

8. Advanced knowledge in some specific areas of mathematics, such as differential equations, geometry and topology, complex analysis, probability and statistics, number theory, or numerical analysis.

Policies

Program Policies

Declaring the Joint Major

The prerequisite for declaring the joint major in Mathematics and Computer Science is completion of either CSCI-UA 101 Intro to Computer Science or CSCI-UA 102 Data Structures (depending on placement) with a C or better.

Joint Mathematics and Computer Science Major Policies

1. Students may double count no more than two courses with another major or a minor.
2. Courses taken under the Pass/Fail option do not count toward the major. There are no exceptions.
3. A grade of C or better is required in any and all courses used to fulfill major requirements.
4. In accordance with CAS policy, nine of the eighteen 4-credit courses (36 credits) required for the major must be taken in the College of Arts and Science. Transfer students typically complete five 4-credit courses (20 credits) in MATH-UA and four 4-credit courses (16 credits) in CSCI-UA. Transfer students to the College must pay careful attention to these rules.

Required Coursework in CAS (-UA) for all Majors and Minors in Courant

At least half of the courses applied to the Courant requirements of the CAS majors and minors in Computer Science and in Mathematics (including joint programs) must be CSCI-UA and MATH-UA courses taken in New York or at NYU study away sites. This is a built-in limit on how many courses students may take in these subjects that are (for example) sponsored by NYU Abu Dhabi and NYU Shanghai under CS-UH, MATH-UH, CENG-SHU, CSCI-SHU, and MATH-SHU. Internal and external transfers must pay close attention to this policy, but it also applies to students who matriculate as first-years. The usual CAS policies on -UA residency for the baccalaureate degree still apply.

Restrictions

1. Tandon School of Engineering students are not permitted to declare this joint major as a similar joint major is offered at their home school.
2. Students who are planning to declare or have already declared a major in Data Science are not permitted to declare this joint major; there is significant course overlap between the requirements of the major in Data Science and the requirements of the joint major in Mathematics and Computer Science. Students interested in combining computer science, data science, and mathematics should consider the joint CAS major in Computer and Data Science.

School of Engineering Courses

CAS students (in any major or minor) are not permitted to take computer science courses in the Tandon School of Engineering.

NYU Policies

University-wide policies can be found on the New York University Policy pages (https://bulletins.nyu.edu/nyu/policies/).

College of Arts and Science Policies

A full list of relevant academic policies can be found on the CAS Academic Policies page (https://bulletins.nyu.edu/undergraduate/arts-science/academic-policies/).