

THE COMMITTEE ON COMPUTATIONAL AND APPLIED MATHEMATICS

Committee website: <https://cam.uchicago.edu/>

Director

- Guillaume Bal (Statistics, Mathematics, & CCAM)

Professors

- Mihai Anitescu (Statistics, Argonne, & CCAM)
- Rina Foygel Barber (Statistics & CCAM)
- Nisha Chandramoorthy (Statistics & CCAM)
- Aaron Dinner (Chemistry, James Franck Institute, & CCAM)
- Brent Doiron (Statistics, Neurobiology & CCAM)
- Ewain Gwynne (Mathematics & CCAM)
- Gregory Lawler (Mathematics, Statistics, & CCAM)
- Lek-Heng Lim (Statistics & CCAM)
- Panagiotis (Takis) Souganidis (Mathematics & CCAM)
- Nathan Srebro (TTIC, Computer Science, & CCAM)
- Matthew Stephens (Statistics, Human Genetics, & CCAM)
- Shmuel Weinberger (Mathematics, Statistics, & CCAM)
- Rebecca Willett (Statistics, CCCAM, & Computer Science)

Associate Professor

- Pedram Hassanzadeh (CCAM & Geophysical Sciences)
- Risi Kondor (Statistics, CCAM, & Computer Science)
- Daniel Sanz-Alonso (Statistics & CCAM)

Assistant Professors

- Yuxin Chen (Computer Science & CCAM)
- Promit Ghosal (Statistics & CCAM)
- Jeremy Hoskins (Statistics & CCAM)
- Yuehaw Khoo (Statistics & CCAM)
- Frederic Koehler (Statistics, CCAM, & DSI)
- Tian Li (Statistics, CCAM, & DSI)
- Cong Ma (Statistics & CCAM)

Assistant Senior Instructional Professors

- Eric Baer (Statistics & CCAM)
- Kendra Burbank (Statistics & CCAM)

Affiliates

- Fausto Cattaneo (Astronomy and Astrophysics)
- Carlos Kenig (Mathematics)
- Arvind Murugan (Physics & CCAM)
- Gregory Voth (Chemistry and James Franck Institute)

Emeritus

- Yali Amit (Statistics, Computer Science, & CCAM)
- Mary Silber (Statistics & CCAM)

THE PROGRAM

The use of computational, mathematical and statistical modeling in various areas of science has increased dramatically in recent years, triggered by massive increases in computing power and data acquisition. Mechanistic models for physical problems that reflect underlying physical laws are being combined with data-driven approaches in which statistical inference and optimization play key roles. These developments are

transforming research agendas throughout statistics and applied mathematics, and are impacting a broad range of scientific disciplines.

A critical need now exists to train the next generation of computational and applied mathematicians to confront data-centric problems in the natural and social sciences. In response to these developments, the Committee on Computational and Applied Mathematics (CCAM) has been formed to provide graduate training in Computational and Applied Mathematics that reflects both the scientific demands and the unique strengths of the University of Chicago faculty across the Division of the Physical Sciences, including the recent hiring of several new faculty under a Computational and Applied Mathematics Initiative (CCAM).

ADMISSIONS

The program will admit a small number of exceptionally qualified students. Each student will be assigned to a member of the computational and applied mathematics committee to plan and approve a student's course of study until their dissertation committee is formed. The executive committee monitors each student's progress through the program at quarterly meetings.

COURSE REQUIREMENTS

First-year students are required to register for three courses per quarter for a total of nine (9) graduate courses during their first year in the program. They are required to follow the analytical sequence:

- Applied Dynamical Systems (CAAM 31410 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam31410>)),
- Applied Functional Analysis (CAAM 31210 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam31440>)),
- Partial Differential Equations (CAAM 31220 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam31220>))

as well as the computational sequence:

- Mathematical Computation I: Matrix Computation (CAAM 30900 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam30900>)),
- Mathematical Computation II: Optimization (CAAM 31020 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam31020>) or CAAM 31015 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam31015>)),
- Applied Approximation Theory (CAAM 31050 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam31050>)).

They should receive a grade of B or above in each course and have an average of B+ or above in each sequence. The remaining three courses may be chosen freely from CAM-related graduate programs at The University of Chicago. Approval for the three electives is required from the first-year PhD student advisor.

Graduate students are required to complete a third sequence during their first three years in the program. The sequence is composed of

- Machine Learning (CAAM 37710 (<https://voices.uchicago.edu/cammasters/course-offerings/#caam37710>))

or equivalent and two classes from the following list:

- Measure Theoretic Probability (STAT 38100, STAT 38300, STAT 38510),
- Data Assimilation and Inverse Problems,
- Variational Methods in Image Processing,
- Monte Carlo Simulations,
- Foundations of Computational Dynamics,
- Numerical PDE,
- Fast Algorithms,
- Algorithms for Massive Datasets,
- Computational Neuroscience (CAAM 42610).

Additional graduate courses in the PSD may be considered for the sequence with approval from CCAM. Students should receive a grade of B or above in each course and have an average of B+ or above in the sequence. The above list will be updated based on course availability. Course substitutions based on specific research interests and funding requirements are possible and need approval from the student's PhD advisor and CCAM leadership.

Students who do not complete these requirements as noted above may be placed on academic probation.

Graduate students need to complete at least twelve (12) CAM-related graduate courses to graduate.

QUALIFYING EXAMS

Graduate students take written qualifying exams at the end of their first year, typically over two days during the second week of June. The qualifying exams consist of two four-hour exams. The first exam focuses on the three topics of the analytical sequence while the second exam covers the three topics of the computational sequence. Students are expected to display sufficient mastery in all six topics.

Each exam will receive a grade of Pass, Conditional Pass, or Fail. Conditional Pass becomes a Fail if conditions are not met.

Students failing both exams with very low scores may be dismissed from the program at the end of their first year. Students failing one or more exams will need to retake those exams the following year. Students failing to pass the qualifying exams for a second time may be dismissed from the program at the end of their second year.

THESIS ADVISOR AND DISSERTATION COMMITTEE

Students are encouraged to identify a potential PhD advisor at the end of their first year to engage/enroll in a summer Reading & Research course. If such an advisor cannot be identified, students are required to present a plan for their first-year summer quarter that needs approval from CCAM.

PhD students are free to change PhD advisors during their enrollment in the program. PhD advisors are free to discontinue working with a PhD student and then cease to be the student's advisor should the collaboration not meet expectations.

Students are required to form a thesis committee once they have a designated advisor. The committee will first meet (in person) at the end of the student's second year. If such a thesis committee cannot be formed, students need to present a plan for their future in the program that will need to be approved by CCAM.

The thesis committee is composed of a minimum of three researchers physically present in Chicago. At least two members need to be affiliated with CCAM. Thesis committees report to CCAM on student progress at the end of every academic year.

Students are expected to present progress in their PhD work to the thesis committee at the end of year 3, and again at the end of year 4.

Our expectation is for students to graduate at the end of their fifth year in the program. Staying in the program for a sixth year requires approval by CCAM. Students would need to petition by the end of Winter quarter of their fifth year, provide a research plan for completing their degree in a timely manner, and receive approval from their PhD advisor.

PROPOSAL PRESENTATION AND ADMISSION TO CANDIDACY

No later than the end of Autumn Quarter of the fourth year, students should have scheduled and completed a proposal presentation to their committee, in order to be advanced to candidacy. The proposal presentation is typically an hourlong meeting that begins with a 30-minute presentation by the student, followed by a question and discussion period with the committee. The proposal meeting will be scheduled by the student and his or her committee and reported to the CAM student affairs administrator. Acceptance of the proposal by the Dissertation Committee is a formal requirement of CAM's Ph.D. program; all committee members must sign the form approving the proposal. After a successful proposal presentation, the student will be formally admitted to candidacy for the Ph.D. degree. The dissertation defense cannot occur earlier than 8 months after admission to candidacy, and the student should keep this in mind when scheduling both the proposal presentation and the defense.

Following advancement to candidacy, during each year that the student remains, the student is required to have a yearly meeting with the dissertation committee leading up to the final thesis defense.

DISSERTATION DEFENSE

The Ph.D. degree will be awarded following a successful defense and the electronic submission of the final version of the dissertation to the University's Dissertation Office. In this process, a number of University and Department deadlines have to be obeyed. Listed in reverse order, the steps are:

a) Submission of Final Version of Dissertation:

The deadline is set by the University and is generally on a Friday in the 6th or 7th week of the quarter when the degree will be awarded. See:

- Information for Ph.D. Students: <https://www.lib.uchicago.edu/research/scholar/phd/students/>
- Dissertation Deadlines: <https://www.lib.uchicago.edu/research/scholar/phd/students/dissertation-deadlines/>

for this deadline as well as guidelines for the formatting of dissertations.

b) Dissertation Defense:

The thesis defense will be an open seminar announced to the department. Following the regular question-and-answer session, the committee will remain, together with any interested faculty, and continue questioning the candidate. The decision on the thesis will then be reached in a closed meeting of the faculty present. The defense is to be scheduled at least two weeks before the University deadline indicated in point (a). A final draft of the dissertation must be made available to the entire faculty 8 days before the dissertation presentation.

c) Committee Approval of Scheduled Defense:

A draft of the dissertation should be distributed to the members of the dissertation committee no later than five weeks before the dissertation defense. At least four weeks before the defense, the student must file a departmental form in the Department office, signed by all members of the dissertation committee, indicating that the student can reasonably expect to defend the thesis within four weeks.

These rules delineate the minimum level of involvement of the dissertation committee. We strongly recommend that students set up their committees early and that they interact regularly with the members of their committees once they are established. In particular, we strongly recommend that those students wishing to complete the degree before September schedule their defense before the Summer Quarter, else unanticipated committee requirements may lead to the degree being delayed to the Winter Quarter.

For more details on this new program, see <https://cam.uchicago.edu/academics/graduate-programs/phd-program/>.

M.S. DEGREE PROGRAM AND REQUIREMENTS

The main requirement of the M.S. program is successful completion of a sequence of at least nine approved courses.

Students who wish to do so can pursue the option of a master's degree with thesis. Students who pursue this option are required to complete the above course requirements and write and defend a master's thesis under the guidance of a CAM advisor. The option without master's thesis may be completed in nine months (three full-time quarters) or more. The option with a master's thesis may be completed in 15 months (four full-time quarters, excluding summer) or more. Both options can extend up to two years of courses.

A detailed set of requirements and milestones can be found at <https://voices.uchicago.edu/cammasters/current-students/>. A substantial fraction of available courses are the same as for the Ph.D. degree.

