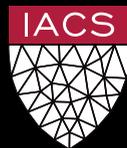


# Master's Programs in Computational Science and Engineering and Data Science



Harvard John A. Paulson School of Engineering and Applied Sciences

**IACS** Institute for Applied  
Computational Science

4. You are only and always accountable to the data and the task: a good model is one that includes full disclosure of choices you made, good rationale for making them and honest discussion of potential drawbacks.



Harvard's Institute for Applied Computational Science (IACS) is the home of leading graduate degree programs in data science and computational science and engineering.

Housed within the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), IACS is where students and faculty tackle major challenges in science and the world through the use of computational methods.



## WHY HARVARD?

The **interdisciplinary nature** of IACS master's programs attracts students with a wide range of academic and professional backgrounds. We provide the flexibility to explore electives chosen to meet your interests.

Students are fully embedded within the academic life at Harvard and will be able to take advantage of electives across departments and activities around campus.

We offer **project-based courses** to give students the opportunity to implement what they have learned in their courses as well as to improve their communication and teamwork skills.

Students will have a **research experience** during their master's studies, which can be fulfilled through our Capstone Project course or by working with faculty members from across the university on an independent study or master's thesis project.

Taking advantage of the Institute's **close connections** with industry, students interact with industry leaders working on cutting-edge research through the IACS seminar series, tech trek visits to partner companies in Boston, NYC, and Silicon Valley, and the IACS Capstone Project course. Recent Capstone partners have included Spotify, Google, TripAdvisor, the MBTA, Square Capital, and the Associated Press.

# COMPUTATIONAL SCIENCE AND ENGINEERING

The **Master of Science (SM)** and **Master of Engineering (ME) in CSE** are one- and two-year programs of study offered by the Harvard John A. Paulson School of Engineering and Applied Sciences. Students will achieve expertise in modeling simulation as well as algorithms, parallel programming and analysis, and visualization of large data sets. Coursework includes a core of four courses in **Applied Mathematics** and **Computer Science**.

To earn the SM in CSE, a candidate will complete eight courses and present a poster on a CSE project at the annual IACS Project Showcase. To earn the ME in CSE, a candidate must also complete a year-long research project culminating in a thesis.

## COURSE REQUIREMENTS

A TOTAL OF 8 COURSES FROM THESE CATEGORIES	NUMBER REQUIRED
Numerical Methods (AM 205)	1
Additional core courses: CS 205, AM 207, CS 207	2
Research Experience (AC 297r or AC 299r)	1
Applied Math elective	1
Computer Science elective	1
Additional courses:	2
Applied Math electives (up to 2)	
Computer Science electives (up to 2)	
Domain electives (up to 2)	
Research course (up to 1)	
AC 298r Seminar course (up to 1)	
<b>TOTAL</b>	<b>8</b>

# COURSE REQUIREMENTS

A TOTAL OF 12 COURSES FROM THESE CATEGORIES	NUMBER REQUIRED
Technical core: AC 209A, AC 209B, CS 207, AM 207	4
Critical Thinking and Data Science (AC 221)	1
Research Experience (AC 297r or AC 299r)	1
Computer Science elective	1
Statistical elective	1
Additional courses:	4
Computer Science electives (up to 4)	
Statistical electives (up to 4)	
Other Data Science electives (up to 4)	
Research course (up to 1)	
Seminar course (up to 1)	
<b>TOTAL</b>	<b>12</b>

# DATA SCIENCE

## The Master of Science (SM) in Data Science

is a three-semester program of study offered by the Harvard John A. Paulson School of Engineering and Applied Sciences and the Faculty of Arts and Sciences. The program offers strong preparation in statistical modeling, machine learning, optimization, management and analysis of massive data sets, and data acquisition. Key topics are reproducible data analysis, collaborative problem solving, visualization and communication, and security and ethical issues that arise in data science. Coursework includes a core of four technical courses in Data Science, Computer Science, and Applied Math.

To earn the SM in Data Science, a candidate will complete 12 courses and present a poster on a Data Science project at the annual IACS Project Showcase.

# APPLIED COMPUTATION COURSES 2019–2020

## CORE COURSES:

### APPLIED MATH 205 \* | FALL 2019

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#### Advanced Scientific Computing: Numerical Methods

An examination of the mathematical foundations of a range of well-established numerical algorithms, exploring their use through practical examples.

### APPLIED MATH 207 \*† | FALL 2019

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#### Advanced Scientific Computing: Stochastic Methods for Data Analysis, Inference and Optimization

Develops skills for computational research with a focus on stochastic approaches, emphasizing implementation and examples.

### COMPUTER SCIENCE 205\* | SPRING 2020

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#### Computing Foundations for Computational Science

An applications course highlighting the use of computers in solving scientific problems. Emphasizes parallel programming and “parallel thinking.”

### COMPUTER SCIENCE 207 \*† | FALL 2019

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#### Systems Development for Computational Science

A project-based course emphasizing designing, building, testing, maintaining and modifying software for scientific computing.

\* CSE CORE COURSE

† DATA SCIENCE CORE COURSE

### APPLIED COMPUTATION 209a † | FALL 2019

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#### Data Science 1: Introduction to Data Science

Data Science 1 is the first half of a one-year introduction to data science. Introduces methods for five key facets of an investigation: data wrangling, cleaning, and sampling; data management; exploratory data analysis; prediction; and communication of results through visualization, stories, and interpretable summaries.

### APPLIED COMPUTATION 209b † | SPRING 2020

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#### Data Science 2: Advanced Topics in Data Science

Data Science 2 is the second half of a one-year introduction to data science. Advanced methods for data wrangling, data visualization, and statistical modeling and prediction are introduced. Topics include big data and database management, interactive visualizations, nonlinear statistical models, and deep learning.

### APPLIED COMPUTATION 221 † | SPRING 2020

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#### Critical Thinking in Data Science

This course examines the wide-ranging impact data science has on the world and how to think critically about issues of fairness, privacy, ethics, and bias while building algorithms and predictive models that get deployed in the form of products, policy and scientific research. Topics will include algorithmic accountability and discriminatory algorithms, black box algorithms, data privacy and security, ethical frameworks; and experimental and product design.

## SELECTED ELECTIVES:

APPLIED COMPUTATION 290r | Extreme Computing

APPLIED COMPUTATION 298r | Interdisciplinary Seminar in Applied Computation

APPLIED MATH 221 | Advanced Optimization

APPLIED MATH 225 | Advanced Scientific Computing II

APPLIED MATH 227 | Computational Methods in Physical Sciences

APPLIED MATH 231 | Decision Theory

COMPUTER SCIENCE 165 | Data Systems

COMPUTER SCIENCE 171 | Visualization

COMPUTER SCIENCE 181 | Machine Learning

COMPUTER SCIENCE 281 | Advanced Machine Learning

COMPUTER SCIENCE 282r | Topics in Machine Learning

STATISTICS 131 | Time Series and Prediction

STATISTICS 139 | Linear Models

STATISTICS 14 | Generalized Linear Models

## RESEARCH EXPERIENCES:

**APPLIED COMPUTATION 297r | FALL 2019**

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### **Computational Science and Engineering Capstone Project**

A real-world project-based course where students apply the skills and ideas acquired in their core courses and electives.

**APPLIED COMPUTATION 299r | FALL 2019 OR SPRING 2020**

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### **Special Topics in Applied Computation**

Independent study research on topics in applied computation supervised by IACS affiliated faculty.



## WHO ARE OUR STUDENTS?

We value diversity and welcome students from around the world who bring a range of previous academic, professional, and personal experiences to the program. Most of our students have technical and quantitative backgrounds with undergraduate degrees from a wide range of fields: computer science, economics, mathematics, social sciences, statistics, and humanities.

## ALUMNI PROFILES



### **Jody Schechter, S.M. '14**

Data Scientist/Senior Consultant, QuantumBlack

Jody Schechter came to IACS following a two-year stint as a data miner at an online consumer analytics firm, Compete. For her, studying computational science and engineering was a way to enhance her skills in a growing field. Since the program, Schechter has worked both as a data science consultant with Booz Allen Hamilton and as an in-house data scientist at Akamai, a content distribution network. Today she is again working as a data science consultant, this time with QuantumBlack, a McKinsey company. Schechter enjoys the variety in her work and loves that every few months she's working with a new, unique client to solve advanced analytics problems.



### **Jeff Shen, S.M. '15**

Senior Data Scientist, Uber

After his undergraduate studies, alumnus Jeff Shen worked at an economic consulting firm in Cambridge, MA building models to understand the energy market. It was at this job that he realized he didn't have enough understanding of the statistical and simulation techniques he was using, so he decided to pursue a graduate degree at IACS. Shen appreciated the smaller program size and diversity of his cohort, and he enjoyed the opportunity to meet with industry practitioners through the Capstone course and visits to tech companies. Since graduating, Shen has held jobs with Yelp as a data scientist and machine learning engineer and now works at Uber on real-time driver surge pricing.

## CAREER OUTCOMES

Harvard offers unparalleled resources for career and internship placement, as well as access to an extensive alumni network, regular opportunities for career counseling, interview coaching, visits to tech companies, and numerous career fairs throughout the year.

Typical job titles for program graduates include: **Data Scientist, Software Engineer, Program/Product Manager, Investment Analyst, Machine Learning Engineer**

Starting salaries for graduates of the Computational Science and Engineering or Data Science programs are between **\$80,000 - \$140,000.**





## GRADUATES HAVE GONE ON TO WORK AT:

**TECHNOLOGY:** Dropbox, Microsoft, Uber, Intel, Yelp, eBay, Facebook, Amazon, SquareSpace, Toast, Quora, NVIDIA    **GOVERNMENT/MILITARY:** U.S. Coast Guard, MIT Lincoln Labs, Naval Air Warfare Center    **INVESTMENT/FINANCE:** The Blackstone Group, J.P. Morgan Chase, Bank of America, Bloomberg, Goldman Sachs, Nasdaq    **ADVERTISING/MARKETING:** Integral Ad Science, ADP, Intent Media, YieldMo, Tribe Dynamics, LiveRamp    **ACADEMIA:** MIT, Johns Hopkins, Harvard Center for Astrophysics    **MEDIA:** BuzzFeed, Legendary Entertainment    **CONSULTING:** Booz, Allen, Hamilton, McKinsey

## TO APPLY:

IACS takes a holistic approach to admission, taking all relevant application materials into account. There are no GRE or GPA cutoffs.

There are no formal prerequisites for applicants to our master's programs. However, successful applicants do need to have sufficient background in Computer Science, Math, and Statistics - including fluency in at least one programming language and knowledge of calculus, linear algebra, and statistical inference.

Candidates apply through the Graduate School of Arts and Sciences.

Visit [gsas.harvard.edu/apply](https://gsas.harvard.edu/apply)

**The 2020 application deadline is December 15, 2019**

For general questions, email us at [iacs-info@seas.harvard.edu](mailto:iacs-info@seas.harvard.edu)

For admissions questions, email us at [iacsadmissions@seas.harvard.edu](mailto:iacsadmissions@seas.harvard.edu)

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