In 2014–2015, the Institute for Applied Computational Science welcomed a new executive director, Cathy Chute, and a new program manager, Sheila Coveney, to help build and support the master’s program and expand and grow the institute’s public and community efforts, which include workshops, a symposium, and seminars for the Harvard community and the public.

Cathy is the former Publisher of Harvard Magazine as well as the Executive Director of the Ivy League Magazine Network. Before coming to Harvard, Cathy was a director of new business development at the New York Times. In addition to her marketing and business development background, Cathy has extensive teaching and student advising experience at Harvard Extension school and Harvard Business School publishing’s online corporate learning division. She also has been a consultant and adviser to early-stage non-profit organizations. Sheila comes to us from Stanford University where she worked for the Vice Provost for Undergraduate Education Office to help implement a new undergraduate breadth requirement. Previously she was housing coordinator at Harvard’s Graduate School of Arts and Sciences and a department administrator in the Freshman’s Dean’s Office.

During the past year the institute experienced unprecedented demand for the master’s program and computational courses. As a result, relationships with companies and organizations have been strengthened to support student recruiting and research opportunities, and to continue engagement with practitioners and thought leaders in industry and government, supporting the institute’s role as the intellectual home for faculty and students applying computational methods to major challenges in science and the world.
Fall 2014
IACS started off the 2014–15 year by welcoming 29 master’s students who comprised the second cohort of the computational science and engineering (CSE) program. The cohort hailed from the U.S., China, Taiwan, Egypt, and Australia. The fall semester was a busy one as students settled into a routine of classes and even started the job search process - in October the cohort connected with companies at the Big Data Fair at Harvard and heard from four local CSE alums who returned to campus to share advice and perspective on the job hunt.

ComputeFest and Wintersession Activities
In January, five students escaped the cold of Cambridge and traveled to Chile to put their computational skills to work with analysis of astronomical data pulled from the Dark Energy Camera at Cerro Tololo Inter-American Observatory near La Serena, Chile. Led by Scientific Program Director, Pavlos Protopapas, the students collaborated with their peers at the University of Chile and even discovered a new asteroid! Back in Cambridge, Harvard students, staff, faculty and industry partners attended the first week of IACS’s annual ComputeFest program, which included public hands-on workshops in software tools and computational approaches. The following week, IACS sponsored a computational challenge, where Harvard students were given anonymized data and asked to re-identify the data source by using statistical inference, and a day-long symposium on data privacy, which included a variety of speakers from industry and academia.

Spring 2015
The spring semester was an active one with many CSE students taking part in the program’s launch of the project-based capstone course. Students tackled a variety of real-world research problems such as predicting passenger patterns on the MBTA, identifying establishments with high human-trafficking potential with USAid, and analyzing subscription cues at the Boston Globe. IACS also led students on local tech treks to meet with data scientists and software engineers at companies such as Google, EnerNOC, and Legendary Films. Over spring break twenty students joined Executive Director, Cathy Chute, and Assistant Director of Graduate Studies, Daniel Weinstock, on a two-day trek to New York City where they visited five companies in media, advertising, and finance, and networked with NYC alumni.

In spring, IACS received a grant from the National Science Foundation to run a three-year summer program to be hosted by the IACS, beginning in June 2015 – the Team Research in Computational and Applied Mathematics Research Experience for Undergraduates, open to students from around the U.S.
Surge in Interest in the Program Reflects Student Demand

Interest in the Computational Science and Engineering program has grown significantly in the past year, evidenced by a 117% increase in applications for the 2015–2016 program compared to the previous year. IACS offered admission to fewer students as a percentage of total applications, yet the percentage of students who accepted admission grew from 57% in 2014–15 to 72% in 2015–16.

---

### Nationality of Admitted Students

<table>
<thead>
<tr>
<th>Year</th>
<th>Australia</th>
<th>Canada</th>
<th>Chile</th>
<th>France</th>
<th>Germany</th>
<th>India</th>
<th>Italy</th>
<th>Korea</th>
<th>Lebanon</th>
<th>Netherlands</th>
<th>Pakistan</th>
<th>Saudi Arabia</th>
<th>Spain</th>
<th>Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>5</td>
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<td></td>
<td></td>
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<td>24</td>
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<td>11</td>
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<tr>
<td>2014</td>
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<td>2015</td>
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<td>16</td>
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</table>
IACS Course Enrollment

Overall course enrollment at the Harvard Paulson School has grown significantly since the School was created in 2007, and IACS courses have been a significant part of that growth. There were nearly 500 course enrollments in IACS courses during the 2014–2015 academic year. The Data Science course (shown below in orange) continues to draw large enrollments of graduate and undergraduate students.

2014 – 2015 Student Cohort

Undergraduate Majors

Math
Computer Science
Economics/Finance
Engineering

Years Since Undergraduate Degree

0 Years
1 - 3 Years
More than 3 Years
## Where Did 2014–15 CSE Students Go After Graduation?

<table>
<thead>
<tr>
<th>Sector</th>
<th>Company or Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td>1010data</td>
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<tr>
<td></td>
<td>CDK Global</td>
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<tr>
<td></td>
<td>Dropbox</td>
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<td></td>
<td>Google</td>
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<td>Hudl</td>
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<td>Intel</td>
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<td>Kyruus</td>
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<td>MathWorks</td>
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<tr>
<td></td>
<td>Microsoft</td>
</tr>
<tr>
<td></td>
<td>Uber</td>
</tr>
<tr>
<td><strong>Start-Ups</strong></td>
<td>Driven Data</td>
</tr>
<tr>
<td></td>
<td>IDHT-PR</td>
</tr>
<tr>
<td><strong>Government / Military</strong></td>
<td>Lawrence Livermore National Lab</td>
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<tr>
<td></td>
<td>MIT Lincoln Laboratory</td>
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<tr>
<td></td>
<td>Naval Air Warfare Center</td>
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<tr>
<td></td>
<td>U.S. Coast Guard</td>
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<tr>
<td><strong>Investment / Finance</strong></td>
<td>Bloomberg</td>
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<tr>
<td></td>
<td>Citadel</td>
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<td></td>
<td>Goldman Sachs</td>
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<td></td>
<td>The Blackstone Group</td>
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<td></td>
<td>The Thasos Group</td>
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<tr>
<td><strong>Marketing / Advertising</strong></td>
<td>Integral Ad Science</td>
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<tr>
<td></td>
<td>Intent Media</td>
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<tr>
<td></td>
<td>Liveramp</td>
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<td></td>
<td>Tribe Dynamics</td>
</tr>
<tr>
<td></td>
<td>Yieldmo</td>
</tr>
<tr>
<td><strong>Media / Entertainment</strong></td>
<td>BuzzFeed</td>
</tr>
<tr>
<td></td>
<td>Legendary Entertainment</td>
</tr>
<tr>
<td><strong>Consulting</strong></td>
<td>Booz, Allen, Hamilton</td>
</tr>
<tr>
<td></td>
<td>Boston Consulting Group</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>Exxon Mobil</td>
</tr>
<tr>
<td><strong>Academia / Other</strong></td>
<td>Harvard Business School</td>
</tr>
<tr>
<td></td>
<td>Harvard Statistics Department</td>
</tr>
<tr>
<td></td>
<td>Max Planck Institute</td>
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<td></td>
<td>Ping An Insurance</td>
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<td></td>
<td>Stanford University</td>
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<td>Verifi</td>
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</tbody>
</table>

*Students reported starting salaries between $80,000 – $140,000.*

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*CSE alumna Jody Schechter of Booz, Allen, Hamilton greets students at the Big Data Career Fair held on campus October 2014.*

*CSE new graduates celebrate on commencement day.*
Secondary Field Program Grew by 52% From Previous Year, Attracting Students from a Wide Variety of Disciplines

Open to Ph.D. students in the Graduate School of Arts & Sciences, the Computational Science and Engineering (CSE) Secondary Field (Harvard’s term for a minor) equips students across disciplines with an understanding of rigorous computational methods for approaching scientific questions. In 2015, six Ph.D. students graduated with their Secondary Field in CSE. Forty-seven students are currently in the program.

**Major Field of Study for CSE Secondary Field Students**

- **Social Sciences**
  - Economics
  - Psychology
  - Public Policy
  - Sociology

- **School of Engineering & Applied Sciences (SEAS)**
  - Applied Math
  - Applied Physics
  - Computer Science
  - Bioengineering
  - Engineering Sciences
  - Environmental Science and Engineering

- **Statistics**
  - Statistics
  - Biostatistics

- **Sciences**
  - Astronomy
  - Biophysics
  - Chemistry and Chemical Biology
  - Earth and Planetary Sciences
  - Organismic and Evolutionary Biology
  - Physics
  - Virology

*Secondary Field Student Ariana Minot presents her work at the IACS Project Showcase.*
ComputeFest 2015

Each January, IACS sponsors ComputeFest, a two-week program that includes one week of skill-building workshops, a three-day student computational challenge, and finally a day-long symposium on the future of computation in science and engineering. This year’s symposium was co-hosted with the Center for Research on Computation and Society (CRCS) at the Harvard Paulson School.

- 695 people attended ComputeFest workshops where they learned hands-on skills in Python, R, GPU Computing, Deep Learning, Mathematica, Amazon AWS, and MATLAB.

- 37 Harvard students registered in the Student Computational Challenge, where they competed against one another on a de-anonymization problem.

- 700 people attended the Privacy in a Networked World symposium, which featured thought leaders in academia and industry, including Bruce Schneier, Fellow at Harvard’s Berkman Center for Internet & Society in conversation with Edward Snowden, former systems administrator at the National Security Agency, and John DeLong, Director of the Commercial Solutions Center at the National Security Agency.
From Cambridge to the Andes
For the second year, five Harvard students traveled to Santiago and La Serena, Chile to take part in the Chile-Harvard Innovative Learning Exchange Program. The program aims to provide students the experience of working with noisy and imperfect data sets while collaborating with international peers.

Students from Harvard and the University of Chile were placed into teams and provided four terabytes of real images from the Dark Energy Camera (DECam), which included artifacts such as missing data and cosmic rays. Teams were asked to identify all sources in the images, determine the shape and brightness of each object, and ultimately to classify objects as galaxies, stars or asteroids.

Back in Cambridge, the Harvard students presented their findings, which revealed the discovery of an asteroid, as a part of the IACS Seminar Series.

Summer in Cambridge
Through collaboration between IACS and the undergraduate Applied Math program at SEAS, the Team Research in Computational and Applied Mathematics (TRiCAM) program launched in the summer of 2015. Funded by a grant from the National Science Foundation, TRiCAM brought 16 undergraduates from across the United States to campus for 10 weeks with the goal of providing students an opportunity to learn first-hand about the research process, and engage with the larger research community at Harvard.

Working in small teams, students used computation and mathematical tools to tackle projects posed by Harvard faculty and industrial partners. Projects included:

- Boston Area Research Initiative: Can Boston area 311, 911 and geo coded Twitter data be used to observe the responses of the city to the 2013 Boston Marathon bombing?
- Quantum Reservoir Impact: Can deep learning be used to predict oil well production?
- Harvard Institute for Quantitative Social Science: Creating a tool for social scientists that integrates audio and video features into a program for topic modeling of text documents.
Thanks to the generosity of an anonymous donor, IACS has been able to offer fellowships to a small group of students in the Computational Science and Engineering (CSE) program. This year, three students in the secondary field program and one student in the master’s program were awarded funds to cover their tuition for the fall semester and continue the research they are passionate about.

IACS Fellowship Program

CSE Secondary Field Recipients:

**Dogus Cubuk**
Dogus is a 5th year Ph.D. student in Applied Physics. Using stochastic simulations and graph-theoretic tools in conjunction with quantum mechanical calculations, Dogus’ research includes analyzing and designing battery materials and amorphous solids in general. Recently, he has focused his time on applying machine learning algorithms to materials science.

**Bo Liu**
Bo is a 4th year Ph.D. student in Physics who is focusing on computational and theoretical physics. Bo is studying the resonant scattering of light by gold nanoparticles. Bo’s research uses a stochastic optimization method to shape the electromagnetic fields into alphabetic letters on the nanometers scale. The results of this work are relevant to the design of more flexible platforms for controlling body interactions.

**Dylan Nelson**
Dylan graduated in May with a Ph.D. in astrophysics. Using large supercomputer simulations, Dylan investigated the question of how cosmic gas flows from diffuse intergalactic space into the centers of galaxies, providing the fuel for the formation of stars.

**Masters of Engineering Recipient:**

**Ryan King**
Using computational techniques learned in the CSE program, Ryan is working with medical physicists at Massachusetts General Hospital to optimize the delivery of radiation in the treatment of large cerebral arteriovenous malformations.

IACS Visiting Faculty and Post-Doc Program

IACS welcomes collaboration with visiting faculty and post-docs, who contribute to and enrich the mission of the Institute.

**Karim Pichara**, Assistant Professor at the Computer Science Department at Pontificia Universidad Católica de Chile, visited IACS in July 2015 to collaborate with IACS Scientific Program Director, Pavlos Protopapas. Together, the researchers developed a new machine learning technique that learns how to automatically integrate stellar objects classifiers to produce a more general, flexible and adaptive model.

**Professor Sauro Succi**, Director of Research at the Institute for Computing Applications of the National Research Council of Italy, visited IACS in the fall of 2014. Professor Succi is one of the founders of the successful Lattice Boltzmann method for fluid dynamics. At Harvard, Professor Succi taught Computational Modeling of Fluids and Soft Matter, and will return to teach the course again in the fall of 2015.

In the fall of 2015, IACS will welcome the following collaborators:

- **Jean-Daniel Fekete**, Senior Research Scientist in information visualization and human-computer interaction at Université Paris-Sud, will collaborate with IACS Director and Professor of Computer Science, Hanspeter Pfister.
- **Niv Dayan** will join IACS as a post-doctoral fellow, collaborating with Computer Science Professor Stratos Idreos. Niv specializes in algorithm design for storage technologies and completed his Ph.D. in Computer Science at ITU University of Copenhagen.
- **Terry Yoo**, from the Office of High Performance Computing and Communications at the National Library of Medicine will be an industry visitor at IACS.
- **Harikrishna Narasimhan** will join IACS as a post-doctoral fellow, collaborating with Computer Science Professors David Parkes and Yaron Singer. Harikrishna specializes in machine learning and completed his Ph.D. at the Indian Institute of Science in Bangalore.
2014 – 2015 Seminars

Using Big Data in Epidemiology for Digital Disease Detection: Lessons Learned and New Directions
Mauricio Santillana  Harvard SEAS

High-Throughput Screening of Crystalline Porous Materials
Chris Rycroft  Harvard SEAS

Computational Network Dynamics of the Neocortex
Nima Dehghani  Wyss Institute

D.E. Shaw Research Information Session
Gennette Gill and Alexander Ramek  D.E. Shaw Research

Marrying Domain Knowledge and Computational Methods
Ashish Mahabal  California Institute of Technology

Data Science at The New York Times
Chris Wiggins  The New York Times

Over-coming the Fluid-Structure Added-Mass Instability for Incompressible Flows
William D. Henshaw  Rensselaer Polytechnic Institute

Tree-like Structure in Social and Information Networks
Aaron Adcock  Facebook

Data-Mining for Development
Shankar Kalyanaraman  Facebook

Orderly Randomness: Quasirandom Numbers and Quasi-Monte Carlo
Brian Hayes  IACS Fellow

Connectomics: Extracting Neural Connectivity From Very Large Data Sets
Thouis Ray Jones  Harvard SEAS

Free Software in Finance
Rich Frank, Delaney Granizo-Mackenzie, Andrew Campbell  Quantopian

Chile-Harvard Innovative Learning Exchange
Diana Zhang, Sabrina Zhou  Harvard CSE

Orderly Randomness: Quasirandom Numbers and Quasi-Monte Carlo
XuFei Wang  Harvard Statistics

Billions and Billions of Molecules: Exploring Chemical Space
Alan Aspuru-Guzik  Harvard Chemistry and Chemical Biology

Summarizing Large Data Sets
Jeffrey A. Bilmes  University of Washington

Big Data, Geospatial Computing, and My 2 Cents in an Open Data Economy
Budhendra Bhaduri  Oak Ridge National Laboratory

Data: A Love Story: How Data Science, and a Great Deal of Tinkering, Created the Biggest Dating Site in the U.S.
Christian Rudder  OkCupid


A Conversation Between Bruce Schneier and Edward Snowden, addressing the proposition “Society needs new conceptions of privacy”
Bruce Schneier  Berkman Center for Internet & Society
Edward Snowden  Formerly at the National Security Agency

Privacy in a Networked World
John DeLong  National Security Agency

Privacy and Irony in Digital Health Data
John Wilbanks  Sage Bionetworks

The Mete and Measure of Privacy
Cynthia Dwork  Microsoft Research

Protecting Privacy in an Uncertain World
Betsy Masiello  Google

Sur-veillance, Sous-veillance and Co-veillance
Lee Rainie  Pew Research Center

What Privacy Does Society Demand Now and How Much is New?
Danny Weitzner  MIT CSAIL
Kobbi Nissim  Ben-Gurion University
Nick Sinai  Walter Shorenstein Media and Democracy Fellow
Latanya Sweeney  Harvard Faculty of Arts & Sciences

IACS New Ventures: The Internet of Things – January 30, 2015

Speakers discussed the extraordinary entrepreneurial opportunities at the frontiers of computational science and cyberphysical systems.

Colin Angle  iRobot
David Rose  Ditto Labs; Former CEO, Ambient Devices
Chad Jones  Virtual Potential Advisors
Members of the IACS Advisory Board and CSE Program Committee


Novartis  • Michael Brenner*  Harvard SEAS  • David Brown  Lawrence Berkeley National Laboratory  • Jennifer Chayes  Microsoft Research  • George Colony  Forrester Research  • John R. Dowdle  Draper Laboratory  • Remy Evard  Novartis  • Doug Finkbeiner  Harvard Astronomy/Physics  • Bruce Fischl  Harvard Medical School/ Massachusetts General Hospital  • Mark Fishman  Novartis  • David Gilmour  Blyth Capital Partners  • Fawwaz Habbal  Harvard SEAS  • Stratos Idreos  Harvard SEAS  • Raphael Irizzary  Harvard School of Public Health/Statistics  • Bernadette Johnson  MIT Lincoln Laboratory  • Efthymios Kaxiras*  Harvard SEAS  • Gary King*  Harvard Institute for Quantitative Social Science  • Eddie Kohler  Harvard SEAS  • Zhiming Kuang*  Harvard SEAS/Earth & Planetary Sciences  • HT Kung  Harvard SEAS  • Jeff Lichtman  Harvard Molecular & Cellular Biology  • David Luebke  NVIDIA  • Sebastien Matringe  QRI  • Jim McLean  Crosslink Capital  • Brendan Meade  Harvard Earth & Planetary Sciences  • James Misewich  Brookhaven Labs  • Greg Morrisett  Harvard SEAS  • Cherry Murray  Harvard SEAS  • Ramesh Narayan  Harvard Astronomy  • Nitin Nohria  Harvard Business School  • Michael Papka  Argonne National Laboratory  • David C. Parkes*  Harvard SEAS  • Hanspeter Pfister*  Harvard SEAS  • Bonnie Ray  IBM  • Ros Reid  Harvard SEAS  • Mark Russell  Raytheon  • Chris Rycroft*  Harvard SEAS  • Jeffrey Saltzman  AstraZeneca  • Jeffrey Schnapp  Harvard Graduate School of Design  • Rachel Schutt  News Corp  • Margo Seltzer*  Harvard SEAS  • Sadasivan Shankar  Harvard SEAS  • Justin Sheehy  VMWare  • Yaron Singer  Harvard SEAS  • Joy Sircar  Harvard SEAS  • Michael D. Smith  Harvard Faculty of Arts & Sciences  • Guy Steele  Oracle  • Fred Streitz  Lawrence Livermore National Laboratory  • Latanya Sweeney  Harvard Faculty of Arts & Sciences  • Rita Tavilla  VMWare  • Nora Tgavalekos  Raytheon  • Sallie Vadhan  Harvard SEAS  • Fernanda Viegas  Google  • John Wakeley  Harvard Organismic & Evolutionary Biology  • Jim Waldo*  Harvard SEAS  • Christopher Yu  Draper Laboratory

*Member, CSE Program Committee

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Research Visitors and Student Researchers

Patricio Benavente  Associate  • Augustin Cosse  Fellow  • Giacomo Fal cucci Visiting Scholar  • Brian Hayes  Fellow  • Raul Jimenez  Associate  • Isadora Nun Fellow  • Karim Pichara  Associate  • Lucas Valenzuela Pugh  Associate  • Rosalind Reid  Fellow  • Alexander Wissner-Gross  Fellow  • Terry Yoo  Associate

Harvard John A. Paulson School of Engineering and Applied Sciences

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