What is the CSE program?
Who are the CSE Students?
Where do students go after CSE?
The CSE Curriculum
The application process
Outside the classroom
The curriculum is designed to train students in techniques and methods from **Applied Math** and **Computer Science** and to apply that toolkit to solve problems in a **domain of interest**.
Created in 2010 and charged with launching interdisciplinary education and research programs in computational science and engineering (CSE)
IACS Advisory Board

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Outcome Based Learning

1: reproducible computational solution
2: communicate across disciplines
3: model complex systems
4: advanced data analysis
5: breakthrough in domain of science
6: parallel and distributed computing
7: multiple computational approaches
8: software engineering
Who are CSE Students?
Who are CSE Students?
Where do CSE Students go after graduation?

Typical Job Titles: Data Scientist, Software Engineer, Product Manager, Big Data Developer, Operations Research Analyst, Investment Analyst

Source: 2013 CSE Student Data
The CSE Curriculum
# Master of Science: course requirements

A Total of 8 courses from these categories:

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core: AM 205/207; CS 205/207</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Applied Math electives</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Computer Science electives</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Domain electives</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>AC 297r Capstone course</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>AC 298r Seminar</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>AC 299r research course</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
AM205 Advanced Scientific Computing: Numerical Methods

Scientific computing has become an indispensable tool in many branches of research, and is vitally important for studying a wide range of physical and social phenomena. In this course we will examine the mathematical foundations of well-established numerical algorithms and explore their use through practical examples drawn from a range of scientific and engineering disciplines.

- Data Fitting
- Numerical Linear Algebra
- Numerical Calculus & Differential Equations
- Nonlinear Equations & Optimization
- Eigenvalue Problems
This is an applications course highlighting the use of computers in solving scientific problems. You will be exposed to fundamental computer science concepts such as computer architectures, data structures, algorithms, and parallel computing. You will learn the fundamentals of scientific computing including abstract thinking, algorithmic development, and assessment of computational approaches. And you will use a series of open source tools and libraries for data analysis, modeling, and visualization of real scientific problems. A big emphasis in the course is on parallel programming and “parallel thinking.”

- Parallelism and Cloud Computing
- Thinking Parallel and Distributed Computing
- Emerging High Performance Computing
- Application Studies
AM207 Advanced Scientific Computing: Stochastic Optimization Methods

Develops skills for computational research with focus on stochastic approaches, emphasizing implementation and examples. Stochastic methods make it feasible to tackle very diverse problems when the solution space is too large to explore systematically, or when microscopic rules are known, but not the macroscopic behavior of a complex system. Methods will be illustrated with examples from a wide variety of fields, ranging from simulating the immune system to strategies for investing in financial markets.

- Machine Precision
- Integration, the non-Monte Carlo approach
- Random numbers
- Monte Carlo
- Markov Chain Monte Carlo
This is an applications course highlighting the use of computers in solving scientific problems. You will learn the fundamentals of developing scientific software systems including abstract thinking, algorithmic development, and assessment of computational approaches. You will use a series of open source tools and libraries for data analysis, modeling, and visualization of real scientific problems.
Applied Math and Computer Science Electives

- Must take at least one of each
- Many pre-approved electives
- If you take all 4 core courses, one core course can count as an AM or CS elective

CSE electives list

The CSE Program Committee has approved the following courses for inclusion as electives in the plan of study.

<table>
<thead>
<tr>
<th>Suggested CSE Applied Math electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AM 201 Physical Mathematics I</td>
<td>fall</td>
</tr>
<tr>
<td>AM 202 Physical Mathematics II</td>
<td>spring</td>
</tr>
<tr>
<td>AM 221 Advanced Optimization</td>
<td>fall</td>
</tr>
<tr>
<td>AC 274 (was AM 274) Computational Fluid Dynamics</td>
<td>spring</td>
</tr>
<tr>
<td>AC 275 (was AM 275) Computational Design of Materials</td>
<td>spring</td>
</tr>
<tr>
<td>STATS 210 Probability Theory and Statistical Inference I</td>
<td>fall</td>
</tr>
<tr>
<td>STATS 220 Bayesian Data Analysis</td>
<td>fall</td>
</tr>
<tr>
<td>STATS 221 Statistical Computing and Visualization</td>
<td>spring</td>
</tr>
<tr>
<td>STATS 285r Statistical Machine Learning</td>
<td>spring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Suggested CSE Computer Science electives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AC 263 Data and Computation on the Internet</td>
<td>fall</td>
</tr>
<tr>
<td>CS 221 Computational Complexity</td>
<td>spring</td>
</tr>
<tr>
<td>CS 222 Algorithms at the Ends of the Wire</td>
<td>fall</td>
</tr>
<tr>
<td>CS 226r Efficient Algorithms</td>
<td>fall</td>
</tr>
<tr>
<td>CS 228 Computational Learning Theory</td>
<td>spring</td>
</tr>
<tr>
<td>CS 246 Advanced Computer Architecture</td>
<td>fall</td>
</tr>
<tr>
<td>CS 262 Distributed Computing</td>
<td>spring</td>
</tr>
<tr>
<td>CS 281 Advanced Machine Learning</td>
<td>fall</td>
</tr>
</tbody>
</table>
Domain Electives

- Approved courses in a domain of study (other than AM/CS)
- If two domain electives are included in the plan of study at least one of them must be computation intensive
- Computationally Intensive Domain electives approved so far:
  - GOV 2430 “Data Science to Save the World”
  - ECON 2149 “Computational Economics”
Research Project Courses

- AC 299r independent study courses
  - Computational projects
  - Advised by a faculty member or IACS lecturer

- AC 297r Capstone course **NEW!!**
  - Spring semester
  - Research project course
  - Students will work in teams on projects proposed by faculty and industrial partners
plus an oral exam on a piece of computational work
Master of Engineering

- Two year degree
- All the requirements of the SM degree, plus a year of research culminating in the defense of a masters thesis
- Master’s thesis proposals due in mid-February of first year
- Students will be informed in March if their proposal has been accepted and they will be allowed to continue for the second year.
Applying

- Fill out the Harvard GSAS application online
  - http://www.gsas.harvard.edu/apply

- Program Selection
  - Program: Engineering and Applied Sciences
  - Subject: SM, ME or AB/SM Computational Science and Engineering
  - Degree: choose one of SM, ME or AB/SM

- Deadline is December 15, 2014

- GRE scores required
  - GMAT not an acceptable substitution

- TOEFL required if the primary language of instruction at your undergraduate institution was not English

- If you are interested in completing a master’s thesis project you should apply directly for the ME degree
Admissions Criteria

- No formal prerequisites, but need sufficient background in CS and Mathematics
  - CS: Programming, course tend to use matlab and/or python
  - Math: Linear Algebra, Differential Equations, Statistical Inference

- No GRE cutoffs

- Holistic approach to admissions incorporating all application materials – previous degrees, GPA, GREs, personal statement, recommendation letter, work experience

- Looking for students who have demonstrated a capacity for advanced computational work and an interest in applied computation
Outside the Classroom
Harvard and Cambridge
IACS SEMINAR SERIES

- Seminars feature speakers from academia and industry discussing their work applying computation across a variety of fields.
- Fridays 12:30-2:00 PM
- Biweekly
IACS SOCIAL

• Gathering of IACS affiliated student, faculty and staff

• Food and drinks

• Fridays at 4:30 PM
 Computefest 2014

Skill-building workshops

MATLAB • R • Python • Julia
Amazon • UNIX
Computefest 2014

IACS Computational Challenge
Computefest 2014

Future of Computing Symposium
Using computational skills to solve big data challenges from the Dark Energy Camera, a cutting-edge astronomical instrument.

3 CSE SM students, 3 PhD students, and 6 Chilean graduate students worked in teams of four for two weeks.

Trip included outing to Valparaiso and journey to Cerro Tololo to meet with astronomers.

Funded with support from David Rockefeller Center for Latin American Studies and IACS.
Students achieved the following learning outcomes:

- Work with real data where artifacts, noise, etc. are present
- Explore an open ended problem with open ended answers
- Adjust approaches midstream given what the data are telling
- Collaborate on assigned international teams
Career Planning

- Office of Career Services
  - Career Fairs – Big Data and Technology, Startups
  - Individual Career Advising
  - On Campus Interviewing

- IACS recruiting events
  - DE Shaw Research
  - LiveRamp
  - Hudl
CSE Alumni Network

iLab Field Trip

Alumni Career Panel