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# Justin Solomon

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## Education

- 2010-2015 **Ph.D. in Computer Science, Stanford University** (Advisor: Leonidas Guibas) *Stanford, CA*  
Geometric Computing Group, Department of Computer Science  
• Dissertation: "Transportation Techniques for Geometric Data Processing"  
• Distinction in Teaching (completed 2013)  
• Hertz Foundation Graduate Fellowship, National Science Foundation (NSF) Graduate Research Fellowship, and National Defense Science & Engineering Graduate (NDSEG) Fellowship
- 2010-2012 **Master of Science in Computer Science, Stanford University** (Advisor: Leonidas Guibas) *Stanford, CA*  
Qualifying exam in Computer Science Theory (topic: "PDE Approaches to Graph Analysis")
- 2006-2010 **Bachelor of Science, Stanford University** (Advisors: Leonidas Guibas and Richard Schoen) *Stanford, CA*  
Double major in Computer Science (honors) and Math (honors); GPA: 4.138
- 2002-2006 **Thomas Jefferson High School for Science and Technology (TJHSST)** *Alexandria, VA*

## Research Experience

- 2016-Present **MIT, Department of Electrical Engineering & Computer Science** *Cambridge, MA*  
*X-Consortium Career Development Assistant Professor:* Lead the Geometric Data Processing group in MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), studying problems processing, analysis, and editing of geometric data; teach and develop instructional material for undergraduate and graduate courses.
- 2015-2016 **Princeton University, Program in Applied & Computational Mathematics** *Princeton, NJ*  
*Postdoctoral fellow:* Helped design optimization algorithms for cryo-electron microscopy (PI: A. Singer); research and collaboration in geometry processing, computer graphics, machine learning, and other disciplines; presented findings at academic conferences and symposia.
- 2010-2015 **Stanford University, Geometric Computing Group** *Stanford, CA*  
*Graduate Research Assistant:* Developed algorithms for geometry processing, machine learning, and graphics using techniques from continuous differential geometry, partial differential equations, and optimization; collaborated with researchers at Stanford and other universities; presented findings at academic conferences and group meetings; led instruction and development of course materials.
- 2014 **University of Southern California, Department of Computer Science** *Los Angeles, CA*  
*Visiting Research Fellow:* Studied numerics for Markov chain Monte Carlo (MCMC) sampling and performance capture with machine learning and graphics groups; led seminars and discussions on optimal transportation and geometric PDE; guest lecturer in introductory computer graphics course.
- 2007-2012 **Pixar Animation Studios, Tools Research Group** *Emeryville, CA*  
*Summer Intern (2008, 2009), Part Time Research Assistant (2008-10, 2012):* Designed efficient algorithms for image processing using local histograms; examined alternatives to the bilateral filter for computational photography, stylization, and painterly rendering; implemented filters on the GPU and in Pixar's compositing software; prepared SIGGRAPH submissions and other papers. *Summer Intern (2007):* Designed specialized linear solvers with fast rates of convergence for cloth simulation; demonstrated these algorithms using Pixar's physics simulation system.
- 2008-2010 **Stanford University, Geometric Computing Group** *Stanford, CA*  
*Research Assistant:* Formulated methods for replicating regular surface features and detecting intrinsic symmetries; developed algorithms for approximating Killing vector fields to represent continuous surface self-isometries using machinery from discrete and continuous Riemannian geometry.
- 2010 **British Library Sound Archive, Edison Fellowship Program** *London, UK*  
*Visiting Researcher:* Studied the history of Elgar's Cello Concerto using traditional and computerized techniques; developed software to visualize differences between various cellists' interpretations of the Concerto.
- 2007-2008 **Stanford University, Fedkiw Group** *Stanford, CA*  
*Research Assistant:* Supported research in hair simulation by implementing hair rendering and reflectance models; contributed to testing frameworks for computational geometry methods.
- 2006 **Mitsubishi Electric Research Laboratory, Computer Vision Applications & Devices** *Cambridge, MA*  
*Summer Intern:* Designed multilinear models for representing face shape and reflectance simultaneously.
- 2005-2007 **MITRE Corporation** *McLean, VA*  
*Technology Intern (part time on call):* Developed a framework for iris recognition using multi-camera input; presented the system to engineers consulting for the US Department of Homeland Security.

2005	<b>Massachusetts Institute of Technology (MIT), Computer Graphics Group</b> <i>Mentorship (Research Science Institute):</i> Applied multilinear modeling to face shape estimation from reflectance/video.	Cambridge, MA
2005	<b>Computer Science Department, George Mason University</b> <i>Computer Vision Mentorship:</i> Proposed and implemented methods estimating obstacle rate of approach from video.	Fairfax, VA
2004	<b>Naval Research Laboratory, Virtual Reality Department</b> <i>Summer Intern:</i> Devised algorithms for surface analysis for face recognition from shape.	Washington, DC

## Teaching Experience

### Introduction to Machine Learning (6.036)

MIT

*Co-Instructor (Spring 2018):* Part of team of four faculty instructors; lead two sections through interactive exercises; assist in course material revision and development.

### Introduction to Computer Graphics (6.837)

MIT

*Co-Instructor (Fall 2016), Instructor (Fall 2017):* Gave weekly course lectures; managed two course assistants (64 students, with W. Matusik in 2016).

### Shape Analysis (6.838)

MIT

*Instructor (Spring 2017):* Designed, organized, and presented a new course on low- and high-dimensional geometric algorithms including topics from graphics, vision, and machine learning.

### Symposium on Geometry Processing Graduate School

Several locations

*Lecturer (Summer 2015, 2016):* Introduced modern optimization algorithms applied to shape analysis in a tutorial called "Optimization Techniques for Geometry Processing" (with D. Bommes). *Lecturer (Summer 2014):* Introduced applications of the Laplace-Beltrami operator in a tutorial entitled "Laplace-Beltrami: The Swiss Army Knife of Geometry Processing" (with K. Crane and E. Vouga). *Lecturer (Summer 2012):* Introduced shape descriptors and matching to new researchers in geometry processing.

### Mathematical Methods for Computer Vision, Robotics, and Graphics (CS 205A)

Stanford University

*Instructor (Fall 2013, Spring 2015):* Redesigned and developed new materials for a course on numerical techniques with applications focus; gave weekly lectures; managed four course assistants; wrote comprehensive course notes that have been expanded into a textbook (40+ students in 2013, 100+ students in 2015).

### Differential Geometry for Computer Science (CS 468)

Stanford University

*Co-instructor (Spring 2013):* Developed and taught a new research-level course; weekly lecturer on discrete applications of differential geometry, alternating with theoretical discussions; developed practical and written assignments and projects to accompany lecture material (15 students, with A. Butscher).

### Computer Graphics: Geometric Modeling (CS 348A)

Stanford University

*Course assistant (Winter 2013):* Led weekly section and office hours; redesigned assignments and project to reflect developments in geometry processing; guest lecture on polar forms, derivatives, and continuity.

### Introduction to Computer Graphics and Imaging (CS 148)

Stanford University

*Instructor (Summer 2012):* Reorganized course to reflect a broader view of graphics; created assignments, lectures, and exams; mentored students after end of the course in research; managed course assistants; held office hours; included speakers from industry; shared materials with colleagues seeking new graphics curriculum (32 students).

### Computer Graphics: Geometric Modeling (CS 348A)

Stanford University

*Course assistant (Winter 2012):* Led weekly section on topics from class, student questions, and related topics (e.g. shared structure between Bézier curves and elliptic curve cryptography; Plücker coordinates; subdivision); held office hours; guest lecturer on mesh parameterization.

### Programming Methodology (CS 106A)

Stanford University

*Section leader (Winter 2009):* Led weekly section (~10 students); met individually with students to discuss assignments.

## Publications

### Textbook

#### Numerical Algorithms

Justin Solomon (published by AK Peters/CRC Press, 2015; 392 pages)

### Papers and Articles

R. Barnes & JS. **Gerrymandering and Compactness: Implementation Flexibility and Abuse.** *ArXiv* 1803.02857, 2018.

S. Claiçi, E. Chien, & JS. **Stochastic Wasserstein Barycenters.** *ArXiv* 1802.05757, 2018.

Yue Wang, Y. Sun, Z. Liu, S. Sarma, M. Bronstein, & JS. **Dynamic Graph CNN for Learning on Point Clouds.** *ArXiv* 1801.07829, 2018.

JS. **Optimal Transport on Discrete Domains.** AMS Short Course on Discrete Differential Geometry 2018, San Diego.

M. Bessmeltsev & JS. **Vectorization of Line Drawings via PolyVector Fields.** *ArXiv* 1801.01922, 2018.

D. Ezuz, JS, & M. Ben-Chen. **Reversible Harmonic Maps between Discrete Surfaces.** *ArXiv* 1801.02453, 2018.

- M. Essid & JS. **Quadratically-Regularized Optimal Transport on Graphs**. *SIAM Journal on Scientific Computing*, 2018.
- JS. **Computational Optimal Transport**. *Snapshots of Modern Mathematics from Oberwolfach*, 2017.
- M. Staib, S. Claiici, JS, & S. Jegelka. **Parallel Streaming Wasserstein Barycenters**. NIPS 2017, Long Beach.
- G. Peyré, L. Chizat, F. Vialard, & JS. **Quantum Optimal Transport for Tensor Field Processing**. *European Journal of Applied Mathematics* 2017.
- Yu Wang, M. Ben-Chen, I. Polterovich, & JS. **Steklov Geometry Processing: An Extrinsic Approach to Spectral Shape Analysis**. *ArXiv 1707.07070*, 2017.
- S. Claiici, M. Bessmeltsev, S. Schaefer, & JS. **Isometry-Aware Preconditioning for Mesh Parameterization**. Symposium on Geometry Processing 2017, London.
- D. Ezuz, JS, V. Kim, & M. Ben-Chen. **GWCNN: A Metric Alignment Layer for Deep Shape Analysis**. Symposium on Geometry Processing 2017, London.
- JS, A. Vaxman, & D. Bommers. **Boundary Element Octahedral Fields in Volumes**. *Transactions on Graphics* 36.3, 2017.
- E. Corman, JS, M. Ben-Chen, L. Guibas, & M. Ovsjanikov. **Functional Characterization of Intrinsic and Extrinsic Geometry**. *Transactions on Graphics* 36.2, 2017.
- S. Berkiten, M. Halber, JS, C. Ma, H. Li, & S. Rusinkiewicz. **Learning Detail Transfer based on Geometric Features**. Eurographics 2017, Lyon.
- T. Glozman, JS, F. Pestilli, & L. Guibas. **Shape Attributes of Brain Structures as Biomarkers for Alzheimer's Disease**. *Journal of Alzheimer's Disease*, 2016.
- JS, G. Peyré, V. Kim, & S. Sra. **Entropic Metric Alignment for Correspondence Problems**. SIGGRAPH 2016, Anaheim.
- M. Tao, JS, & A. Butscher. **Near-Isometric Level Set Tracking**. Symposium on Geometry Processing 2016, Berlin.
- G. Peyré, M. Cuturi, & JS. **Gromov–Wasserstein Averaging of Kernel and Distance Matrices**. ICML 2016, New York City.
- JS, R. Rustamov, L. Guibas, & A. Butscher. **Continuous-Flow Graph Transportation Distances**. *ArXiv 1603.06927*, 2016.
- JS, F. de Goes, G. Peyré, M. Cuturi, A. Butscher, A. Nguyen, T. Du, & L. Guibas. **Convolutional Wasserstein Distances: Efficient Optimal Transportation on Geometric Domains**. SIGGRAPH 2015, Los Angeles.
- W. Chao, JS, D. Michels, & F. Sha. **Exponential Integration for Hamiltonian Monte Carlo**. ICML 2015, Lille.
- JS, R. Rustamov, L. Guibas, & A. Butscher. **Earth Mover's Distances on Discrete Surfaces**. SIGGRAPH 2014, Vancouver.
- B. Zhu, E. Quigley, M. Cong, JS, & R. Fedkiw. **Codimensional Surface Tension Flow on Simplicial Complexes**. SIGGRAPH 2014, Vancouver.
- JS, R. Rustamov, L. Guibas, & A. Butscher. **Wasserstein Propagation for Semi-Supervised Learning**. ICML 2014, Beijing.
- F. Pestilli, JS, A. Butscher, & B. Wandell. **Model-Based Neuroanatomy: Tractography Validation, White-Matter Connections and Geometrical Organization**. ISMRM 2014 accepted abstract, Milan.
- JS, K. Crane, A. Butscher, & C. Wojtan. **A General Framework for Bilateral and Mean Shift Filtering**. *ArXiv 1405.4734*, 2014.
- JS, L. Guibas, & A. Butscher. **Dirichlet Energy for Analysis and Synthesis of Soft Maps**. Symposium on Geometry Processing 2013, Genoa.
- JS, A. Nguyen, A. Butscher, M. Ben-Chen, & L. Guibas. **Soft Maps Between Surfaces**. Symposium on Geometry Processing 2012, Tallinn.
- JS, E. Vouga, M. Wardetzky, & E. Grinspun. **Flexible Developable Surfaces**. Symposium on Geometry Processing 2012, Tallinn.
- M. Ovsjanikov, M. Ben-Chen, JS, A. Butscher and L. Guibas. **Functional Maps: A Flexible Representation of Maps Between Shapes**. SIGGRAPH 2012, Los Angeles.
- A. Vacavant, A. Albouy-Kissi, P. Menguy, & JS. **Fast Smoothed Shock Filtering**. International Conference on Pattern Recognition 2012, Tsukuba.
- JS, M. Ben-Chen, A. Butscher, & L. Guibas. **As-Killing-As-Possible Vector Fields for Planar Deformation**. Symposium on Geometry Processing 2011, Lausanne.
- JS, M. Ben-Chen, A. Butscher, & L. Guibas. **Discovery of Intrinsic Primitives on Triangle Meshes**. Eurographics 2011, Llandudno.
- M. Kass and JS. **Smoothed Local Histogram Filters**. SIGGRAPH 2010, Los Angeles.
- M. Ben-Chen, A. Butscher, JS, & L. Guibas. **On Discrete Killing Vector Fields and Patterns on Surfaces**. Symposium on Geometry Processing 2010, Lyon.

JS. **Programmers, Professors, & Parasites: Credit and Co-Authorship in Computer Science.** *Science and Engineering Ethics* 15.4 (2009): 467-489.

—. **Deconstructing the Definitive Recording: Elgar's Cello Concerto and the Influence of Jacqueline du Pré.** *The Hofer Prizes for Excellence in Undergraduate Writing* 2009.

—. **Fast and Accurate Estimation of Principal Curvatures and Directions for Morphable Models.** SIGGRAPH 2007 posters, San Diego.

—. **Putting the Science in Computer Science.** *ACM Inroads Magazine* 39.2 (2007), 46-49.

—. **Programming as a Second Language.** *Learning & Leading with Technology* 32.4 (2004-05), 34-39.

—. **Ready, Set, Code** (two-part series in *Learning & Leading with Technology*): **Starting a Computer Team in Your School** (34.7, 2007, pp. 35-6); **Computer Team Competitions** (34.8, 2007, pp. 32-3).

Articles in *ACM Crossroads*: **Introduction** for 16.1 (September 2009), 15.4 (June 2009), 15.3 (March 2009), 15.2 (December 2008), 15.1 (September 2008), 14.4 (June 2008), 14.3 (March 2008), 14.2 (December 2007); **The Science of Shape** 13.4 (June 2007); **SIGGRAPH 2006: Exploring the Art and Science of Computer Graphics** 13.3 (March 2007)

## Patents

**Painterly Filtering** (US 12/493,208, filed June 28, 2009)

Michael Kass, Justin Solomon (original assignee: Pixar)

**Smoothed Local Histogram Filters for Computer Graphics** (US8406518 B2, filed June 28, 2009)

Michael Kass, Justin Solomon, Rick Sayre (original assignee: Pixar)

**Methods and Systems of Comparing Face Models for Recognition** (US 12/416,716, filed April 1, 2009)

Mark Alan Livingston, Justin M. Solomon (original assignee: The United States Of America; Secretary Of The Navy)

## Invited Talks

2018 **Scaling & Broadening the Scope of Computational Transport**

Applied Math Colloquium, MIT Department of Mathematics

2018 **Tutorial on Optimal Transport**

MIT-IBM Watson AI Lab

2018 **Geometric Optimization Algorithms for Variational Problems**

Weizmann Institute of Science Vision & Robotics Seminar

2017 & 18 **Algorithms for Geometrically-Structured Optimization**

Tufts ECE Seminar, KAUST Conference on Visual Computing, Technion CGGC Seminar

2017 & 18 **Beneath the Surface: Geometry Processing at the Intrinsic/Extrinsic Interface**

Quebec Mathematical Sciences Colloquium; keynote, Geometry and Computational Design (GCD 2017, Vienna, Austria); & keynote, Geometric Modeling & Processing (GMP 2018, Aachen, Germany)

2017 **A Primer on Optimal Transport (with M. Cuturi)**

NIPS 2017 tutorial

2017 **The Theory and Practice of Geometric Data Processing**

Keynote, MIT IEEE Undergraduate Research Technology Conference

2017 **Volumetric Shape Analysis from Boundary Representations**

Geometry Workshop, Obergurgl, Austria

2017 **What Mathematicians Reveal about Gerrymandering**

Science for the Public Contemporary Science Issues and Innovations program

2017 **Metric Geometry and Gerrymandering**

Free and Open Source Software for Geospatial (FOSS4G)

2017 **Geometry & Data: Algorithmic Approaches to Redistricting**

Geometry of Redistricting Workshop

2017 **Geometric Data Processing**

Schlumberger-Doll Research

2017 **Intelligent Processing & Navigation of Geometric Data**

CSAIL Systems that Learn board meeting & Samsung Research America

2017 **Scalable Optimization Algorithms for Geometry**

Laboratoire d'Informatique (LIX), École Polytechnique

2017 **Regularized Optimal Transport on Graphs: Rank-1 Hessian Updates for Quadratic Regularization**

Dagstuhl Seminar: Functoriality in Geometric Data

2016 **Structured Assignment: Practical Linear & Quadratic Matching**

Google Vision Group

- 2016 **Toward Quadratic Optimal Transport on Graphs**  
Workshop on Computational Optimal Transportation, Centre de Recherches Mathématiques
- 2016 **Computational Spectral Geometry: Tutorial and Modern Applications**  
Montréal Analysis Seminar
- 2016 **Entropic Metric Alignment for Correspondence Problems**  
Tristate Workshop on Imaging and Graphics
- 2016 **Practical Tools for Applied Linear and Quadratic Matching**  
Data Science Meets Optimization Workshop, RWTH Aachen
- 2016 **Optimal Transportation for Practical Geometric Problems**  
NYU Applied Math Seminar & Technion CGGC Seminar
- 2015 **Convolutional Wasserstein Distances for Geometry Processing**  
Geometry Workshop, Seggau, Austria
- 2014 & 15 **Transportation Techniques for Geometric Data Processing**  
Several institutions
- 2014 **Embracing Uncertainty in Geometric Data Analysis**  
Computer Science Colloquium, University of Southern California
- 2014 **Dual Spaces and Functional Maps**  
Networks of Shapes, Images, and Programs, workshop for Stanford Computer Forum
- 2013 **Representations of Maps Between Surfaces**  
Computer Science Faculty Lunch, Stanford University
- 2013 **Computing and Analyzing Soft Maps**  
Geometry Workshop, Strobl, Austria
- 2012 **Coping with Symmetry in Shape Analysis**  
Industrial Light and Magic, San Francisco
- 2011 **Killing Vector Fields: Infinitesimal Isometries from a Linear Solve**  
Geometry Workshop, Obergurgl, Austria & Institute of Science and Technology, Klosterneuburg, Austria
- 2006 **Algorithmic Gymnastics**  
National Educational Computing Conference, San Diego
- 2004 & 05 **Programming as a Second Language**  
National Educational Computing Conference, New Orleans (2004) and Philadelphia (2005)

## Professional Activities

### Organization and Service

- Co-organizer, Erwin Schrödinger International Institute (ESI) 2019 Thematic Programme on Optimal Transport
- Organizer, Banff International Research Station (BIRS) 2018 workshop on Spectral Geometry: Theory, Numerical Analysis and Applications (with I. Polterovich and N. Nigam)
- Organizer and creator, New England Symposium on Graphics 2017, 2018
- Co-chair for vision and graphics, MIT EECS PhD admissions 2018
- Admissions committee, MIT Master of Science Program in Computation for Design and Optimization (CDO) 2018
- NIPS 2017 Tutorial: A Primer on Optimal Transport (with M. Cuturi)
- Co-organizer, NIPS 2017 Workshop on Optimal Transport & Machine Learning
- Hackathon director & panel speaker, Geometry of Redistricting Wisconsin Workshop 2017
- Organizing committee & hackathon director, Geometry of Redistricting Summer School 2017
- Co-Chair, Symposium on Geometry Processing Graduate School 2017
- CSAIL Lab Branding Committee 2017
- Technical papers program committee, SIGGRAPH 2016, 2017
- NSF AF Small Panel, February 2017
- Program committee, Geometric Modeling and Processing (GMP) 2017
- International Program Committee (IPC), Eurographics 2017
- NDSEG PhD Fellowship Scholarship Evaluation Panel, 2017
- Program committee, Symposium on Geometry Processing (SGP) 2016, 2017
- Program committee, Shape Modeling International (SMI) 2016
- Organizer, NIPS 2014 Workshop on Optimal Transport & Machine Learning (with M. Cuturi and G. Peyré)

### Reviewer

- AAAI
- ACM Transactions on Graphics
- AISTATS
- Applied & Computational Harmonic Analysis
- Communications on Pure & Applied Mathematics
- Computers & Graphics
- Eurographics
- Eurographics State-of-the-Art Reports

- Information Sciences
- International Conference on Machine Learning (ICML)
- J. of Computational Geometry & Applications
- J. of Mathematical Analysis and Applications
- J. of Mathematical Imaging & Vision
- J. of Scientific Computing
- Medical Image Analysis
- NIPS
- Pacific Graphics
- SIAM J. Mathematical Analysis
- SIAM J. on Scientific Computing

- SIBGRAPI
- SIGGRAPH
- SIGGRAPH Asia
- Transactions on Biomedical Engineering
- Transactions on Circuits and Systems for Video Technology
- Transactions on Image Processing
- Transactions on Pattern Analysis & Machine Intelligence
- Transactions on Signal Processing
- Transactions on Visualization & Computer Graphics
- The Visual Computer

## Membership

- Sigma Xi, Scientific Research Honor Society (full member)
- Association for Computing Machinery
- Computer Science Teachers Association

## Honors and Awards

2018	Amazon Research Award
2018	MIT-IBM Watson AI Lab Exploratory Grant
2017-20	Prof. Amar G. Bose Research Fellowship
2017	ACM Future of Computing Academy
2017	Army Young Investigator Award (proposal: "Smooth Modeling of Flows on Graphs")
2017	Forbes 30 Under 30: Science
2015-2016	NSF Mathematical Sciences Postdoctoral Research Fellowship
2011 & 16	U.S. Junior Oberwolfach Fellow, National Science Foundation
2014	George E. Forsythe Memorial Award for Excellence in Student Teaching
2010-2015	Hertz Foundation Fellowship (inaugural Hertz-Google Fellow) & NSF Graduate Research Fellowship
2011-14	Bio-X Travel Subsidy Awardee, Stanford Bio-X Interdisciplinary Program
2010-14	Stanford Applied Music Scholarship
2010-13	National Defense Science and Engineering Graduate (NDSEG) Fellowship
2010	Second Place, Symposium on Geometry Processing (SGP) Best Paper Awards
2010	Edison Visiting Fellowship, British Library
2010	Frederick E. Terman Award for Scholastic Achievement in Engineering, Stanford University
2010	J.E. Wallace Sterling Award for Scholastic Achievement, Stanford University
2010	Outstanding Summerfield Scholar & Undergraduate of the Year, Phi Kappa Psi Foundation
2010	Firestone Medal for Excellence in Undergraduate Research
2009	Pixar Animation Studios Inventor Recognition Award
2009	Hoefer Prize for Excellence in Undergraduate Writing, Stanford University
2008	Barry M. Goldwater Scholarship & Tau Beta Pi Engineering Honor Society
2007	Boothe Prize for Excellence in Writing, Stanford University
2007	Finalist, Stanford CS 248 Video Game Design Competition (Project: "Paper Airplane 3D")
2007	Student Research Competition Finalist and poster presenter, SIGGRAPH 2007
2007	President's Award for Academic Excellence in the Freshman Year, Stanford University
2007	Team Finalist, ACM Intercollegiate Programming Contest (ICPC), Tokyo, Japan
2006	Finalist, Intel Science Talent Search (Project: Three-Dimensional Face Recognition from Video)
2004-2006	Scholarships: National Merit, Naval Research, Micron Science & Tech., Intel Excellence in CS
2006	Awards: Mu Alpha Theta Award; USA Today All-USA High School First Academic Team (5/18/06)
2006	Third Place (National) and First Place (State), Math/CS, Junior Science and Humanities Symposium
2005 & 06	First (05) and Second (06) Grand Prize, Computer Science, International Science and Engineering Fair
2005	Research Science Institute, Massachusetts Institute of Technology (Top Project Presentation Award)
2005	Fellowships: Davidson Institute for Talent Development, Department of Homeland Security
2004	Outstanding Intern Award, Naval Science & Engineering Apprenticeship Program (SEAP)

## Other Activities

2017-Present	Cellist, New Philharmonia Orchestra
2016-Present	Metric Geometry and Gerrymandering Group (MGGG)
2016-Present	Faculty mentor, Research Science Institute (RSI)
2015-2016	Cellist, Bravura Philharmonic Orchestra & Westminster Community Orchestra
2015	Attendee, Fall NSF Grants Conference

2010-2015 Cellist, Stanford University chamber music program  
 2010-2014 Cellist (symphony and chamber music), Palo Alto Philharmonic (principal, 2013-2014)  
 2006-2014 Applied Music Lessons, Stanford Department of Music (cello 2006-2014; piano 2006-2010)  
 2013 Cellist, Stanford Symphony Summer Tour "In Beethovens Footsteps"  
 2012, 13 Mentor, Stanford CS Undergraduate Research Internship (CURIS)  
 2010 Organizer, "A Taste of Palo Alto" (to benefit Ecumenical Hunger Program, East Palo Alto)  
 2009-2010 Treasurer and Financial Manager (09-10), Phi Kappa Psi Fraternity, Stanford University  
 2009-2010 Undergraduate Representative, Department of Computer Science Curriculum Committee  
 2006-2010 Cello Tutor, Tutti Program, Stanford Alliance for Service Through the Arts  
 2009 Student Presenter, Stanford Music Symposium 2009: Reactions to the Record II  
 2008-2009 Head Peer Academic Coordinator, Otero House, Stanford Residential Education  
 2006-2009 Managing Editor (07-09), Associate Editor (06-07), *ACM Crossroads Magazine*  
 2006-2009 Associate Editor (06-07), Section Editor (07-08), Editor in Chief (08-09), *Stanford Undergraduate Research Journal*  
 2008 Speaker and Panelist, Scout Entrepreneurship Seminar, Kauffman Foundation, Kansas City  
 2007 Stanford Freshman Peer Mentor Program  
 2006, 07, 08 Cellist, MIT Summer Philharmonic Orchestra (06), UC Berkeley Summer Symphony (07, 08)  
 2004-2006 Cellist, Washington Metropolitan Philharmonic Orchestra (piano finalist, 2005 Concerto Competition)  
 2002-2006 TJ Computer Team (Freshman Capt. 02-03; Senior Capt. 05-06; Invitational Computing Olympiad 05)  
 2005 Presenter, Interservice/Industry Training, Simulation and Education Conference (I/ITSEC), Orlando  
 1999-2005 Boy Scout Troop 152 (Eagle, Philmont Venture Crew, Order of the Arrow), Vienna VA