Saurabh Vyas, Ph.D.

Contact Information

Mellon Institute, 4400 Fifth Ave, Pittsburgh, PA 15213
https://smvyas.github.io/

Professional Experience

Carnegie Mellon University, Pittsburgh, PA — 2026 –
Assistant Professor
Neuroscience Institute
Biomedical Engineering (courtesy)

Columbia University, New York, NY — 2020 – 2025
Postdoctoral Research Fellow
Mortimer B. Zuckerman Mind Brain Behavior Institute
Advisor: Mark M. Churchland
Co-mentor: Michael N. Shadlen

Applied Physics Laboratory, Laurel, MD — 2011 – 2014
Systems Engineer
Intelligent Systems & Robotics Group

Education

Stanford University, Stanford, CA — 2014 – 2020
Ph.D. in Bioengineering
Thesis: "Neural population dynamics underlying motor learning"
Advisor: Krishna V. Shenoy
Donald B. Lindsley Prize (outstanding thesis award by *Society for Neuroscience*)

Johns Hopkins University, Baltimore, MD — 2008 – 2014
M.S.E. in Biomedical Engineering
B.S. in Biomedical Engineering
B.S. in Electrical Engineering
University Honors

Grants & Fellowships

NIH K99/R00, Pathway to Independence Award (K99NS140554)	2024
NIH F32, Ruth L. Kirschstein National Research Service Award (F32NS124834)	2022
NIH F31, Ruth L. Kirschstein National Research Service Award (F31NS103409)	2017
National Science Foundation IGERT trainee in Mind, Brain, and Computation	2015
Biosciences Travel Grant, Stanford University	2015
National Science Foundation Graduate Research Fellowship	2014
Ric Weiland Graduate Fellowship, Stanford University	2014
Robert C. Byrd Scholarship, State of Maryland	2008
Dorr Family Foundation Scholar, Scholarship for Academic Excellence	2008
Science, Engineering, Apprentice Program Fellow, United States Naval Academy	2008
Science, Engineering, Apprentice Program Fellow, United States Naval Academy	2007

Awards & Honors

Donald B. Lindsley Prize in Behavioral Neuroscience, Society for Neuroscience	2021
Sammy Kuo Award in Neuroscience (Finalist), Stanford University	2018
Best Talk (1st Place), Stanford Bioengineering Retreat	2017
Graduated with University Honors, Johns Hopkins University	2012
People's Choice Award, Medical Device Competition, Rice University	2012
Invention of the Year (Finalist), Johns Hopkins Office of Technology Transfer	2011
Computer Integrated Surgery Project Award, Johns Hopkins University	2011
Merit Scholastic Award, State of Maryland	2008
Distinguished Scholars, State of Maryland	2008
Advanced Placement Scholar with Distinction, CollegeBoard	2008

Publications

Trautmann EM, Hesse JK, Stine G, Xia R, Shude Zhu S, O'Shea DJ, Karsh B, Colonell J, Lanfranchi F, **Vyas S**, Zimnik A, Steinmann NA, Wagenaar DA, Andrei A, Lopez CM, O'Callaghan J, Putzeys J, Raducanu BC, Welkenhuysen M, Churchland MM, Moore T*, Shadlen M*, Shenoy KV*, Tsao D*, Dutta B†, Harris T†, "Large-scale high-density brain-wide neural recording in nonhuman primates." *Nature Neuroscience.* (*,†equal contribution) 2025

Verhein JR*, **Vyas S***, Shenoy KV, "Methylphenidate modulates motor cortical dynamics and behavior." *bioRxiv.* (*equal contribution) 2023

O'Shea DJ*, Duncker L*, Goo W, Sun X, **Vyas S**, Trautmann EM, Diester I, Ramakrishnan C, Deisseroth K, Sahani M†, Shenoy KV†. "Direct neural perturbations reveal a dynamical mechanism for robust computation." *bioRxiv.* (*,†equal contribution) 2022

Sun X*, O'Shea DJ*, Golub MD, Trautmann EM, **Vyas S**, Ryu SI, Shenoy KV, "Cortical preparatory activity indexes learned motor memories," *Nature.* (*equal contribution) 2021

Al Borno M, **Vyas S**, Shenoy KV, Delp SL, "High-fidelity Musculoskeletal Modeling Reveals that Motor Planning Variability Contributes to the Speed-Accuracy Tradeoff," *eLife.* 2021

Vyas S, O'Shea DJ, Ryu SI, Shenoy KV, "Causal role of motor preparation during error-driven learning," *Neuron.* 2020

Vyas S, Golub MD, Sussillo D, Shenoy KV, "Computation through neural population dynamics," *Annual Review of Neuroscience.* 2020

Trautmann EM, Stavisky SD, Lahiri S, Ames KC, Kaufman MT, O'Shea DJ, **Vyas S**, Sun X, Ryu SI, Ganguli S, Shenoy KV, "Accurate estimation of neural population dynamics without spike sorting," *Neuron.* 2019

Even-Chen N*, Sheffer B*, **Vyas S**, Ryu SI, Shenoy KV, "Structure and variability of delay activity in premotor cortex," *PLoS Computational Biology.* (*equal contribution) 2019

Vyas S, Even-Chen N, Stavisky SD, Ryu SI, Nuyujukian P, Shenoy KV, "Neural population dynamics underlying motor learning transfer," *Neuron.* 2018

Gorini C, Iyer SM, **Vyas S**, Ramakrishnan C, Deisseroth K, Delp SL, "Reversible temporally-specific inhibition of muscle using a light-activated chloride channel," *bioRxiv.* 2018

Williams A, Kim TH, Wang F, **Vyas S**, Ryu SI, Shenoy KV, Schnitzer ML, Kolda TG, Ganguli S, "Unsupervised discovery of demixed, low-dimensional neural dynamics across multiple timescales through tensor components analysis," *Neuron.* 2018

Vyas S, Huang H, Gale J, Sarma S†, Montgomery E†, "Complexity of Dynamics in STN Neuronal Systems is reduced in Parkinson's Disease compared to Epilepsy," *IEEE Transactions on Neural Systems and Rehabilitation Engineering.* (†equal contribution) 2016

Christensen AJ*, Iyer SM*, Francois A, **Vyas S**, Ramakrishnan C, Vesuna S, Deisseroth K, Scherrer G, Delp SL. "In Vivo Interrogation of Spinal Mechanosensory Circuits," *Cell Reports.* (*equal contribution) 2016

Vyas S, Meyerle J, Burlina P, "Non-Invasive Estimation of Skin Thickness from Hyperspectral Imaging and Validation using Echography," *Computers in Biology and Medicine.* 2015

Mendrik A, Vincken K, Kuijf H, Breeuwer M, Bouvy W, Bresser J, Alansary A, Bruijne M, Carass A, El-Baz A, Jog A, Katyal R, Khan A, Lijn F, Mahmood Q, Mukherjee R, Opbroek A, Paneri S, Pereira S, Persson M, Rajchl M, Sarikaya D, Smedby O, Silva C, Vrooman H, **Vyas S**, Wang C, Zhao L, Biessels G, and Viergever M, "MRBrainS Challenge: Online Evaluation Framework for Brain Image Segmentation in 3T MRI Scans," *Computational Intelligence and Neuroscience*. 2015

Mukherjee R, **Vyas S**, Juang R, Sprouse C, Burlina P, "Endocardial Surface Delineation in 3D Transesophageal Echocardiography," *Ultrasound in Medicine and Biology*. 2013

Vyas S, Banerjee A, Burlina P, "Estimating Skin Parameters from Hyperspectral Signatures," *Journal of Biomedical Optics*. 2013

Peer-reviewed Conference Submissions

O'Shea DJ, Duncker L, **Vyas S**, Sun X, Sahani, M, Shenoy KV, "Electrical but not optogenetic stimulation drives nonlinear contraction of neural states," Computational and Systems Neuroscience abstract (COSYNE), Lisbon, Portugal. 2022

O'Shea DJ*, Trautmann EM*, Sun X, **Vyas S**, Shenoy KV, "Motor cortical neural dynamics are finely spatially intermingled," Computational and Systems Neuroscience abstract (COSYNE), Online. 2021

Vyas S, O'Shea DJ, Shenoy KV, "Causal role of motor preparation during error-driven learning," Advances in Motor Learning and Motor Control (MLMC), Chicago, I.L. *Talk*. 2019

Willett FR, **Vyas S**, Michaels JA, Henderson JM, Shenoy KV, "Neural network models for closed-loop musculoskeletal arm control," Computational and Systems Neuroscience abstract (COSYNE), Lisbon, Portugal. 2019

Lahiri S, Trautmann EM, Stavisky SD, Ames KC, Kaufman MT, O'Shea DJ, **Vyas S**, Sun X, Ryu SI, Ganguli S, Shenoy KV, "Accurate estimation of neural population dynamics without spike sorting." Computational and Systems Neuroscience abstract (COSYNE), Lisbon, Portugal. 2019

Vyas S, Even-Chen N, Stavisky SD, Ryu SI, Nuyujukian P, Shenoy KV, "Neural population dynamics underlying motor learning transfer," Computational and Systems Neuroscience abstract (COSYNE), Denver, CO. 2018

Vyas S, Even-Chen N, Stavisky SD, Ryu SI, Nuyujukian P, Shenoy KV, "Neural population dynamics underlying covert-to-overt motor learning transfer," Advances in Motor Learning and Motor Control (MLMC), Washington D.C. *Talk*. 2017

Williams A, Kim TH, Wang F, **Vyas S**, Ryu SI, Shenoy KV, Schnitzer ML, Kolda TG, Ganguli S, "Dimension reduction of multi-trial neural data by tensor decomposition," Computational and Systems Neuroscience abstract (COSYNE), Salt Lake City, UT. *Talk*. 2017

Vyas S, Christensen AJ, Mitelut C, Iyer SM, Gratiy S, Delp SL, Anastassiou C, "A point process approach to inferring connectivity from biophysical simulations of Ca2+ fluorescence," Computational and Systems Neuroscience abstract (COSYNE), Salt Lake City, UT. 2016

Vyas S, Gammie J, Burlina P, "Computing Cardiac Strain from Variational Optical Flow in Four-Dimensional Echocardiography," IEEE CBMS: Computer-based Medical Systems. *Talk*. **Finalist - Best Student Paper Award** 2014

Vyas S, Meyerle J, Burlina P, "Cross Validating Hyperspectral with Ultrasound-based Skin Thickness Estimation," IEEE Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (IEEE WHISPERS). 2014

Vyas S*, Burlina P, Kleissas D, Mukherjee R*, "Automated Walks using Machine Learning for Segmentation," International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), Grand Challenge on MR Brain Segmentation (MRBrains13). *Talk*. (*equal contribution) 2013

Vyas S, Banerjee A, Burlina P, "Machine Learning Methods for In Vivo Skin Parameter Estimation," IEEE CBMS: Computer-based Medical Systems. 2013

Vyas S, Mukherjee R, Sosa F, Burlina P, "Endocardium Segmentation in 3D Transesophageal Echocardiography," IEEE ISBI: International Symposium on Biomedical Imaging: From Nano to Macro. 2013

Vyas S, Banerjee A, Garza L, Kang S, Burlina P,"Hyperspectral Signature Analysis of Skin Parameters," SPIE-MI: Proceedings of SPIE Medical Imaging. *Talk*. 2013

Peterson E, Mukherjee R, **Vyas S**, Cornish D, "Galaxy: Link Space Visualization and Analysis of Network Traffic," IEEE Visual Analytics in Science & Technology (VAST-MC3). **Honorable Mention – "Intriguing Visualization"** 2013

Vyas S*, Su S*, Kim R*, Kuo N, Taylor RH, Kang J, Boctor EM, "Intraoperative Ultrasound to Stereocamera Registration using Interventional Photoacoustic Imaging," SPIE-MI: Proceedings of SPIE Medical Imaging. (*equal contribution) 2012

Conference Abstracts

Vyas S, Fakhoury T, Trautmann EM, Liwtin-Kumar A, Shadlen MS, Churchland MM, "Neural population geometry during flexible deductive reasoning," Society for Neuroscience, Chicago, I.L. 2024

Vyas S, Fakhoury T, Trautmann EM, Liwtin-Kumar A, Shadlen MS, Churchland MM, "Neural population geometry during flexible deductive reasoning," Simian Collective, Pittsburgh, P.A. **Selected for a Poster Teaser**. 2024

Vyas S, Fakhoury T, Trautmann EM, Liwtin-Kumar A, Shadlen MS, Churchland MM, "Neural population geometry during flexible deductive reasoning," Neurobiology of Cognition Gordon Research Conference, Waterville Valley, New Hampshire. 2024

Vyas S, Trautmann EM, Fakhoury T, Liwtin-Kumar A, Shadlen MS, Churchland MM, "Hierarchical division of labor during cognitive-motor sequences," Neural Control of Movement, Dubrovnik, Croatia. 2024

O'Shea DJ, Trautmann EM, Sun X, **Vyas S**, Shenoy KV, "Spatial microstructure of motor cortical neural dynamics," Neural Control of Movement, Dubrovnik, Croatia. 2024

O'Shea DJ, Trautmann EM, Sun X, **Vyas S**, Shenoy KV, "Spatial microstructure of motor cortical neural dynamics," Society for Neuroscience, Washington D.C. 2023

O'Shea DJ, Duncker L, Sun X, **Vyas S**, Deisseroth, K, Sahani, M, Shenoy KV, "Optogenetic and electrical perturbations in motor cortex reveal a neural population mechanism for robust computation," Society for Neuroscience, San Diego, C.A. 2022

Willett F, **Vyas S**, Michaels JA, Henderson JM, Shenoy KV, "Feedback control dynamics explain motor cortical activity," Society for Neuroscience, Virtual. 2021

O'Shea DJ, Trautmann EM, Sun X, **Vyas S**, Shenoy KV, "High-density silicon probes reveal signatures of neural circuit organization in motor cortical dynamics." Neural Control of Movement, Online. 2021

Vyas S, O'Shea DJ, Ryu SI, Shenoy KV, "Causal role of motor preparation during error-driven learning," Society for Neuroscience, Chicago, I.L. 2019

Verhein JR*, **Vyas S***, Shenoy KV, "Towards a neural population-level understanding of the effects of methylphenidate (Ritalin) in motor cortex of reaching monkeys," Society for Neuroscience, Chicago, I.L. (*equal contribution) 2019

Trautmann EM, O'Shea DJ, Sun X, **Vyas S**, Ryu SI, Shenoy KV, "Spatially heterogenous tuning in rhesus motor cortex revealed using neuropixels probes," Society for Neuroscience, Chicago, I.L. 2019

Deo DR, Willett FR, Avansino DT, **Vyas S**, Even-Chen N, Hochberg LR, Henderson JM, Shenoy KV, "Neural representation of attempted movement of a paralyzed limb in a person, and implications for intracortical brain-computer interfaces," Society for Neuroscience, Chicago, I.L. 2019

Sun X, O'Shea DJ, Trautmann EM, Golub MD, **Vyas S**, Fisher TG, Ryu SI, Shenoy KV, "Changes in neural population activity underlying the learning of novel arm dynamics," Society for Neuroscience, Chicago, I.L. 2019

Verhein JR*, **Vyas S***, Shenoy KV, "Towards a neural population-level understanding of the effects of methylphenidate (Ritalin) in motor cortex of reaching monkeys," Neural Control of Movement, Toyama, Japan. (*equal contribution) 2019

Sun X, O'Shea DJ, Trautmann EM, Golub MD, **Vyas S**, Fisher TG, Ryu SI, Shenoy KV, "Exploration of distinct neural activity repertoire during learning of new arm dynamics," Neural Control of Movement, Toyama, Japan. 2019

Vyas S, O'Shea DJ, Trautmann EM, Willett FR, Shenoy KV, "Motor cortical preparatory activity is causally involved in visuomotor learning," Society for Neuroscience, San Diego, C.A. 2018

Trautmann EM, O'Shea DJ, **Vyas S**, Shenoy KV, "Recording large populations of neurons with single-cell resolution in nonhuman primates using Neuropixels," Cell-NERF Symposium: Neurotechnologies, Leuven, Belgium. 2018

Even-Chen N, Sheffer B, **Vyas S**, Ryu SI, Shenoy KV, "Spatial encoding of reaches in preparatory motor cortical activity," Neural Control of Movement, Santa Fe, N.M. 2018

Vyas S, Even-Chen N, Stavisky SD, Ryu SI, Nuyujukian P, Shenoy KV, "Brain-machine interface guided movements share a common neural substrate with overt movements," Society for Neuroscience, Nanosymposium on Motor Control and Internal Representations, Washington D.C. *Talk*. **Selected as SfN Hot Topic**. 2017

Even-Chen N, **Vyas S**, Ryu SI, Shenoy KV, "The effect of task dimensionality on BMI performance," Society for Neuroscience, Washington D.C. 2017

Sheffer B, Even-Chen N, **Vyas S**, Ryu SI, Shenoy KV, "Direction and distance decoding accuracy from plan activity in monkey motor cortex," Society for Neuroscience, Washington D.C. 2017

Williams A, Poole B, Maheswaranathan N, Kim TH, Wang F, **Vyas S**, Shenoy KV, Schnitzer ML, Kolda TG, Ganguli S, "Low-dimensional representations of learning in multi-trial datasets," Society for Neuroscience, Washington D.C. 2017

Vyas S, Christensen AJ, Iyer SM, Ramakrishnan C, Deisseroth K, Delp SL, "Optical and computational tools for analyzing somatosensory circuits," Society for Neuroscience, Chicago, IL. 2015

Christensen AJ, Iyer SM, **Vyas S**, Francois A, Scherrer G, Deisseroth K, Delp SL, "Optogenetic tools for perturbing spinal neural circuits," Society for Neuroscience, Chicago, IL. 2015

Iyer SM, Christensen AJ, **Vyas S**, Vesuna S, Francois A, Ramakrishnan C, Deisseroth K, Scherrer G, Delp SL, "Optogenetic interrogation of mammalian mechanosensory and nociceptive circuits," Society for Neuroscience, Chicago, IL. 2015

Vyas S, Nguyen HV, Burlina P, Banerjee A, Garza L, Chellappa R, "Computational Modeling of Skin Reflectance Spectra for Biological Parameter Estimation through Machine Learning," SPIE: Proceedings of SPIE. *Talk.* 2012

Patents

Burlina P, Banerjee A, **Vyas S**, Garza L, "Hyperspectral Imaging for Detection of Skin Related Conditions," U.S. Patent No. 8,761,476. Granted on June 24, 2014. 2014

Talks

Neurosurgery Grand Rounds, Barrow Neurological Institute, Phoenix, AZ, "Neurobiology of flexible deductive reasoning." 2025

Sensorimotor Superlab, Western University, "Neurobiology of flexible deductive reasoning." Virtual. 2024

Janelia Research Campus, Mechanistic Cognitive Neuroscience Junior Scientist Workshop, "Neural computations underlying complex cognitive motor sequences." 2022

Simons-Emory International Consortium on Motor Control, Workshop on Neural Dynamics, "Computation through dynamics." 2020

Princeton University, Tim Buschman's group, "What role does motor preparation play during motor learning." 2020

Columbia University, Daniel Salzman's group, "What role does motor preparation play during motor learning." 2020

Columbia University, Mark Churchland's group, "What role does motor preparation play during motor learning." 2020

Stanford University, Department of Neurobiology, "The Shenoy Lab Evening," Stanford, CA, "Neural population dynamics underlying motor learning." 2019

Advances in Motor Learning and Motor Control (MLMC), Chicago, IL, "Causal role of motor preparation during error-driven learning." 2019

Massachusetts Institute of Technology, Mehrdad Jazayeri's group, Cambridge, MA, "Neural population dynamics underlying visuomotor learning." 2019

University of Chicago, David Freedman's group, Chicago, IL, "Neural population dynamics underlying visuomotor learning." 2019

Carnegie Mellon University, Byron Yu's & Matt Smith's groups, Pittsburgh, PA, "Neural population dynamics underlying visuomotor learning." 2019

University of California, Berkeley, Jose Carmena's group, Berkeley, CA, "Neural population dynamics underlying visuomotor learning." 2019

Stanford University, Invited talk at Center for Mind, Brain, Computation, and Technology (MBCT), Stanford, CA, "Neural population dynamics underlying visuomotor learning." 2019

Johns Hopkins University, Reza Shadmehr's group, Baltimore, MD, "Neural population dynamics underlying visuomotor learning." 2018

Advances in Motor Learning and Motor Control (MLMC), Washington DC, "Neural population dynamics underlying covert-to-overt motor learning transfer." 2017

Society for Neuroscience, Nanosymposium on Motor Control and Internal Representations, Washington DC, "Brain-machine interface guided movements share a common neural substrate with overt movements." 2017

Stanford University, Bioengineering Retreat, Chaminade Resort & Spa, Santa Cruz, CA, "Neural population dynamics underlying motor learning transfer." **Best Talk Award**. 2017

Stanford University, Invited talk to Neurosciences Ph.D. program candidates, hosted by Jay McClelland. "Neural Dynamics and Adaptation for Brain-Machine Interface Control." 2017

Stanford University, Bioengineering Retreat, Chaminade Resort & Spa, Santa Cruz, CA, "Towards a freely moving macaque model for motor neuroscience and brain-machine interfaces." 2016

Google, Invited talk by Thomas Dean, Mountain View, CA, "Estimating Neuronal Connectivity from Calcium Imaging Data." 2015

IEEE CBMS conference in New York, NY, "Computing Cardiac Strain from Variational Optical Flow in Four-Dimensional Echocardiography." 2014

MICCAI workshop in Nagoya, Japan. "Automated Walks using Machine Learning for Segmentation." 2013

ISBI conference in San Francisco, CA, "Endocardium Segmentation in 3D Transesophageal Echocardiography." 2013

SPIE Medical Imaging conference in Orlando, FL, "Hyperspectral Signature Analysis of Skin Parameters." 2013

SPIE conference in Baltimore, MD, "Computational Modeling of Skin Reflectance Spectra for Biological Parameter Estimation through Machine Learning." 2012

SPIE Medical Imaging conference in San Diego, CA, "Intraoperative Ultrasound to Stereocamera Registration using Interventional Photoacoustic Imaging." 2012

Outreach & Service

Satellite Meeting organization, 34th Neural Control of Movement conference 2025
Co-organizer (with Dan O'Shea & Sam McDougle) for the Satellite Meeting on "New Frontiers at the Intersection of Cognition and Motor Control."

ZIGI, Columbia University 2024 – 2025
Board member; Supporting and advocating for people who have been historically marginalized in STEM fields.

ZIPSx, Columbia University 2023 – 2025
Co-organized extramural postdoctoral seminar series, focusing on scientists historically marginalized in science.

Zuckerman Institute Athletics Club, Columbia University 2021 – 2025
Co-founding board member; co-organized running and triathlon activities.

Computational Neuroscience Journal Club, Stanford University 2015 – 2018
Co-founder and co-organizer.

Stanford Biosciences Student Association, Stanford University 2016 – 2019
Mentored first-year biosciences (bioengineering) graduate students.

Center for Mind, Brain, & Computation, Stanford University 2015 – 2019
Organized the Monday evening seminar series; invited and hosted speakers.

Stanford Undergraduate Research Association, Stanford University 2018
Mentored undergraduate students interested in research opportunities.

Biomedical Engineering Society, Stanford University 2018
Mentored undergraduate students interested in bioengineering careers.

Boys and Girls Club, Palo Alto, CA 2015 – 2016
SAT tutoring for high school students in the east Palo Alto area.

ASPIRE Program, Johns Hopkins Applied Physics Laboratory 2013 – 2014
Mentored high school students in robotics, and computer vision.

College Prep Program, Johns Hopkins University 2013 – 2014
Developed an SAT curriculum; lectured a classroom of 20 students.

Tutorial Project, Johns Hopkins University 2018
Tutored math and reading to Baltimore City Elementary school students.

Ad hoc reviewer for: Nature Neuroscience, Nature Communications, Nature Human Behavior, Communications Biology, Cell Reports, Journal of Neural Engineering, Neural Networks, COSYNE

Teaching	EE 124: Introduction to NeuroElectrical Engineering, Stanford University *Co-instructor (with Krishna Shenoy)*	2018
	NBio 227: Techniques in Neuroscience, Stanford University *Guest lecturer on Brain Machine Interfaces*	2017, 2018
	BIOS 230: Biomedical Data Analysis in Matlab, Stanford University *Co-developed and co-instructed 3-week mini course (with Nimit Jain)*	2015
Course Assistant	EE 364a: Convex Optimization, Stanford University	2017, 2018, 2019
	EE 278: Statistical Signal Processing, Stanford University	2018
	EE 376a: Information Theory, Stanford University	2017
	BioE 281: Biomechanics of Movement, Stanford University	2016
	CS 229: Machine Learning, Stanford University	2015
	580.421: Systems Bioengineering Laboratory, Johns Hopkins University	2012