Reception to Honor the
2016 Stanford Interdisciplinary Graduate Fellows

November 3, 2016
4:00 - 6:00 PM
Paul Brest Hall East
Munger Conference Center

Stanford Office of the Vice Provost for Graduate Education
2016
Stanford Interdisciplinary Graduate Fellows

Katherine Amberg-Johnson
William and Lynda Steere Fellow, Bio-X SIGF

Jacqueline Basu
Hsieh Family Fellow

Salil Bhate
Bruce and Elizabeth Dunlevie Fellow, Bio-X SIGF

Sam Corbett-Davies
Karr Family Graduate Fellow

Richard Lee Davis
MacKenzie Larson Price Stanford Interdisciplinary Graduate Fellow

Darrel Rohit Deo
Mona M. Burgess Fellow, Bio-X SIGF

Sahar El Abbadi
William and Eva Price Interdisciplinary Graduate Fellow

Jane Esberg
Christiana Shi Stanford Interdisciplinary Graduate Fellow in International Studies

Chris Ford
Hamamoto Family Graduate Fellow

Kevin Guttenplan
Mark and Mary Stevens Interdisciplinary Graduate Fellow, SIGF affiliated with the Stanford Neurosciences Institute

Kiah Hardcastle
Mark and Mary Stevens Interdisciplinary Graduate Fellow, SIGF affiliated with the Stanford Neurosciences Institute

Johnny Israeli
Bruce and Elizabeth Dunlevie Fellow, Bio-X SIGF

Anna Koster
Stanford Interdisciplinary Graduate Fellow (Anonymous Donor), SIGF affiliated with Stanford ChEM-H

Nathan Lee
Satre Family Fellow
2016
Stanford Interdisciplinary Graduate Fellows

MICHAEL C. LEUNG
Stanford Interdisciplinary Graduate Fellow (Anonymous Donor), Bio-X SIGF

LACHLAN MCNAMEE
Satre Family Fellow

AREK MELKONIAN
Stanford Interdisciplinary Graduate Fellow (Anonymous Donor), Bio-X SIGF

ELAINE NG
Bruce and Elizabeth Dunlevie Fellow, Bio-X SIGF

ARJUN PRABHAKAR
Affymetrix Bio-X Fellow, Bio-X SIGF

AMANDA RABE
Stanford Interdisciplinary Graduate Fellow (Anonymous Donor), Bio-X SIGF

KARA RIOPELLE
Leslie Parker Hume Graduate Fellow

HEATHER ROGAN
Rogers Family Interdisciplinary Graduate Fellow, Bio-X SIGF

ARTEMIS SEAFO RD
Jack and Anita Saltz Fellow

HAN DUO SHI
Rosenberg Ach Family Fellow, Bio-X SIGF

ANNE SIDERS
Morgridge Family SIGF Fellow

ROB VOIG T
Michelle and Kevin Douglas Graduate Fellow

JING FAN WANG
Satre Family Fellow

PHILIP WOMBLE
James and Nancy Kelso Fellow
Katherine Amberg-Johnson
William and Lynda Steere Fellow, Bio-X SIGF
Microbiology and Immunology

The malaria parasite houses an essential organelle called the apicoplast. Because the apicoplast contains pathways not found in the human host, it is an ideal drug target. Despite the clinical and biological significance, our limited understanding of apicoplast biology has restricted drug development efforts. I use a novel screening platform to discover inhibitors of apicoplast biogenesis for potential clinical applications, as well as a tool to uncover molecular players of apicoplast biogenesis.

Jacqueline Basu
Hsieh Family Fellow
Political Science

The stability of a state depends on the legitimacy of its institutions. Legitimacy, in turn, is founded on citizens’ belief that these institutions are valid and deserve their obedience. This widespread citizen “belief,” however, derives from subjective features – norms – which political science lacks clear techniques for analyzing. In my work, I identify two primary lacunae in the contemporary study of legitimacy: the absence of political theory about norms; and empirical methods for studying civil discourse, through which norms are developed and transmitted. My dissertation research aims to address both omissions, using the American ratification period as a case study. To conduct this research, I combine methods from a number of disciplines, informing political theory with sociology; and characterizing civil discourse through historical and computational analysis. This project will advance the development of a vocabulary and method by which to study legitimacy in cases of state formation, state dissolution, and civil conflict.
Two ideas are revolutionizing our efforts in the battle against cancer. The first is immunotherapy, the act of reprogramming our immune cells to target cancer cells. The second is genome engineering - the act of perturbing specific genes in our DNA to reprogram cells. But we have 25,000 genes: which ones, and how, do we perturb them to most effectively fight cancer? Professor Stanley Qi developed the tools to rapidly perturb our genomes in a rich set of ways using CRISPR/Cas9. Professor Garry Nolan has developed the ways to measure the molecular behaviors of cells and tissues in unprecedented detail. By combining these technologies and using my expertise in machine-learning and mathematics, I will map the inputs (the perturbations) to the outputs (the cellular and tissue behaviors). My experimental, computational and theoretical innovations will enable me to reliably and predictably reprogram our cells against cancer.

Traffic stops are the most frequent way in which the public interact with law enforcement. Using data collected with my collaborators from Management Science and Engineering and the Computational Journalism lab, I’m developing new statistical tools to analyze police conduct at these stops. My work so far has focused on investigating racial bias in searches at traffic stops. Subsequent work will explore the policy implications: which search types are most discriminatory? Are more diverse police departments less likely to exhibit bias? Since drugs are the most common form of contraband, have law changes, such as the legalization of marijuana, limited the opportunities for discrimination? These questions are hugely important, and the answers are in our data.
Virtual Reality (VR) promises to revolutionize education, but the ways that this technology will be used are undefined. While some see VR merely as a way to place students into virtual classrooms, I see a future where VR is used to create otherwise impossible experiences where youth learn through inquiry and exploration. My research involves the creation of novel VR learning environments, and weaves together multiple strands of research across education, computer science, and cognitive science in an effort to explore the educational implications of programming and building computational models in a virtual world. This work is part of a larger research program that treats computer science as a multi-faceted medium: one that allows learners to creatively explore concepts in multiple disciplines, acts as a window into cognition, and is an essential subject of study for youth in the information age.

Stroke is the leading cause of long-term motor disability in the U.S., but the mechanisms for motor impairment due to stroke are not completely understood. I am interested in how people use haptic (force and touch) feedback in motor control, especially when normal motor control is disrupted. By using a prosthesis simulator to simulate motor impairment in healthy subjects, I will assess how noise impacts motor control and subsequently determine noise models for various types and degrees of motor impairment. These results may provide evidence that haptic feedback can improve motor control in patients.
Sahar El Abbadi
William and Eva Price Interdisciplinary Graduate Fellow
Civil and Environmental Engineering

My research focuses on recycling of agricultural waste into a high value aquaculture feed supplement in Bangladesh. I use a specific type of bacteria to consume methane that is produced through treatment of agriculture waste. By controlling the growth conditions, the bacteria will produce PHB—a polymer that improves survival of fish and shrimp against disease by stimulating their innate immune system. Fish or shrimp raised on this supplement can be used to increase income and availability of dietary protein in malnourished populations while promoting efficient treatment of agricultural waste. This research will involve laboratory experiments and prototype testing in Bangladesh.

Jane Esberg
Christiana Shi Stanford Interdisciplinary Graduate Fellow in International Studies
Political Science

Dictators from Iran to Venezuela have relied on some popular support to maintain power. Though repression is often treated only as a means to eliminate opposition, my research explores how autocratic repression can be used to retain supporters. To do so, I quantitatively analyze newly compiled information on three repressive behaviors used during the military dictatorships in Chile (1973-1989), Argentina (1976-1983), and Brazil (1964-1985): political killings, the use of courts to try political prisoners, and pop culture censorship. Considering multiple repressive tactics and drawing on fine-grained data sources can provide new insight into how dictators’ repression navigates political limits on their power.
Chris Ford
Hamamoto Family Graduate Fellow
Mechanical Engineering

As of 2012, more than half of the world’s population now lives in cities, and by 2050, more than two-thirds is anticipated due to migration and increased birth rates. To sustain life in these urban environments, a network of independent infrastructural resource systems provide end users with critical resource units such as food, communications, energy, water, and waste management.

My preliminary research finds these same primary infrastructure systems are failing within four failure modes, and both the frequency and strength of forces inducing these failure incidents are indeed increasing. Using a human-centered protocol, my PhD investigation shall ask: “During periods of primary infrastructure system failure, how effectively can a secondary, resilient, urban-situated infrastructure solution generate multiple resource unit types (kCals of food, MHz of bandwidth, MWs of electricity, Gals of water) for urban dwellers in San Francisco, CA?”

As urbanism increases, so too must we enhance our scientific and design research on the larger urban context.

Kevin Guttenplan
Mark and Mary Stevens Interdisciplinary Graduate Fellow, SIGF affiliated with the Stanford Neurosciences Institute
Neurosciences

Many neurological diseases feature the death of neurons, but the mechanisms that mediate cell death in these disorders are unknown. Astrogliosis, the response of a cell-type called “astrocytes” to injury, is common to most diseases of the central nervous system (CNS), and recent studies in our lab suggest that some reactive astrocytes may release a protein that is potently toxic to neurons. In order to understand why neurons die during disease, as well as find new therapeutic targets to halt neuronal death, I am working to both identify the toxic protein secreted by astrocytes as well as determine what pathway causes neurons to die when exposed to the toxic protein.
Kiah Hardcastle
Mark and Mary Stevens Interdisciplinary Graduate Fellow, SIGF affiliated with the Stanford Neurosciences Institute

Neurosciences

Navigation through an environment to a remembered location is a critical skill we use every day. How does our brain accomplish such a task? Over the last few decades, several lines of evidence have suggested that a brain region called medial entorhinal cortex (MEC) supports navigation by encoding information about our location and movement within an environment. For example, MEC neurons in your brain may encode information about which direction you are facing, how fast you are traveling, or where you are located relative to prominent landmarks. However, many neurons might encode multiple features, and may even change their coding properties based on the task at hand. To uncover these complex and interesting properties, I combine machine-learning techniques with data collected from electrodes implanted into mouse MEC. By figuring out what individual MEC neurons encode, we can then begin to understand the basic principles by which our brain supports spatial navigation.

Johnny Israeli
Bruce and Elizabeth Dunlevie Fellow, Bio-X SIGF

Biophysics

Age-related macular degeneration (AMD) is the fourth most common cause of blindness and its origin is in the retinal pigment epithelium (RPE). Can we gain insight into the genetic mechanisms underlying AMD through interrogation of RPE cells? Using RPE cells from a human cohort, we will study how RPE genomics change in response to varying cell environments. Using state-of-the-art artificial intelligence, we will mine the experimental results to identify genetic mechanisms underlying RPE function and, ultimately, AMD.
Chloride ion channels (CLCs) are a family of proteins that regulate the flux of chloride ions across cell membranes. My project focuses on CLC-2, which is the most abundant chloride channel expressed in the brain. Genetic knockouts of CLC-2 exhibit degeneration of white matter and neuronal hyperexcitability, which has been associated with human generalized epilepsy. Despite these observations, the exact physiological role of the channel is unknown, and there is a severe lack of tools in the molecular toolbox to begin to understand CLC-2 function. My research seeks to fill this void by using a combination of computational techniques, electrophysiology, synthetic chemistry, and molecular biology to develop highly selective and potent small-molecule inhibitors of CLC-2.

Designing and implementing cost-effective long-run strategies to address climate change in industrialized democracies require an explicit recognition of the obstacles democratic politics imposes on such a process. Foremost among these are factual misperceptions of the mass electorate, short-termist behavior of elected officials, and the dependence of policymaking on biased interest groups in technically complex domains. Using quantitative empirical analysis, in-depth field work, and survey experiments, my research seeks to diagnose the sources of these obstacles as well as identify effective interventions to overcome them. By integrating findings across these three issues, my research seeks to provide actionable recommendations for public policies and institutional reforms to more effectively address one of the greatest challenges of our time.
**MICHAEL C. LEUNG**  
**Stanford Interdisciplinary Graduate Fellow (Anonymous Donor), Bio-X SIGF**  
**Electrical Engineering**

Nearly 10% of couples will turn to assisted reproductive technologies (ART) such as in vitro fertilization (IVF) despite the high costs (>12,000USD) and low success rates (<25%). My goal is to identify an accurate way to predict the viability of implanted embryos in order to increase the singleton birth rate of IVF procedures. Using a variant of optical coherence tomography (OCT), I will measure structural, mechanical, optical, and temporal properties of early-stage embryos, and then use machine learning algorithms to identify key parameters associated with having a high accuracy for viability prediction.

**LACHLAN MCNAMEE**  
**Satre Family Fellow**  
**Political Science**

My research lies at the intersection of critical race theory and quantitative social science, which means that I seek to empirically identify how legal institutions and state power shape the salience of ethnicity and race in the political sphere. In this vein, my current research project investigates how the plantation of Ulster – a seventeenth century English resettlement scheme that institutionalized a minority Protestant landholding class in Ireland – created the conditions for long-term ethno-religious conflict in Northern Ireland. I hope to illuminate the geopolitical logic behind the creation of legally distinct ethno-religious class and show how this has shaped spatial variance in the salience of the Protestant/Catholic divide to the current day. Related research projects in Namibia and Rwanda also seek to explore the long-term consequences of the institutionalization of race and ethnicity both on contemporary understandings of race and on the spatial prevalence of racial and ethnic political mobilization in the post-colonial context.
Arek Melkonian
Stanford Interdisciplinary Graduate Fellow (Anonymous Donor), Bio-X SIGF
Chemical Engineering

Coeliac disease (CD) is an intestinal, inflammatory autoimmune disease triggered by the ingestion of gluten. In extreme cases, the inflammation and accompanying malabsorption is severe enough to manifest in a child’s failure to thrive. In the stomach, enzymatic digestion of gluten produces a small peptide fragment that is the root cause of the immune response, but it is unclear how the immune system processes this peptide such that the body attacks itself. I hope to use small intestinal organoids—three dimensionally-cultured small intestine—to investigate the mechanisms by which this peptide and its derivatives are presented to the immune system. More insight into the peptide chemistry and immunology of this process could lead to more effective therapeutics for the treatment and/or prevention of CD.

Elaine Ng
Bruce and Elizabeth Dunlevie Fellow, Bio-X SIGF
Bioengineering

About 50-60% of chronically infected hepatitis B virus patients develop cirrhosis and liver cancer. Liver cancer is the third leading cause of cancer-related deaths worldwide, with higher prevalence in developing countries. Most patients with hepatocellular carcinoma (HCC), a form of liver cancer, remain undiagnosed until advanced stage due to a lack of reliable early detection methods. Because giant magnetoresistance (GMR) sensors are significantly more sensitive than standard detection methods, I am developing GMR sensor arrays for a novel high throughput biomarker assay to detect early HCC and hopefully significantly lower mortality. Furthermore, I am designing and building an automated GMR system that enables point-of-care cancer detection in physician offices and resource-limited settings. The system will essentially be a medicinal black box that will provide rapid healthcare results at the push of a button.
Proteins perform the majority of the processes in biology. They are created from genes in all organisms through a process called translation. In translation, a large bio-machine called the ribosome assembles the protein from the amino acid building blocks by reading the genetic sequence as a template. There are four stages of translation, and I am studying the last two stages, where the newly assembled protein is released and the ribosome is reset for the next cycle of translation. I am interested in how the ribosome decides when the protein is complete before release and how the ribosome finds the next gene to translate. By tracking bacterial translation both at the single-ribosome level and at the cellular level, I hope to understand how the regulation of these molecular events influence the protein levels in the cell. New insights learned from these studies can create new strategies for antibiotics development.

Cancer is a disease of over-proliferating cells, and it claims the lives of millions every year. The Cochran lab has developed a molecule that labels cancer cells but not healthy tissue, and can recruit the immune system to destroy the tumor. In collaboration with Immunology and Radiation Oncology departments, I am testing the effect of combining this tumor-targeted molecule with standards of care including radiation and chemotherapy. With this work, I hope to expand treatment options, increase survival, and improve quality of life for cancer patients by reducing the amount of chemotherapy or radiation necessary to elicit tumor reduction.
The dominant business model for producing opera is unsustainable, as rising production costs and declining demand have led to pervasive structural deficits in production companies. The paradigmatic solution involves presenting canonical works to attract a large audience and donor base, yet with this model, cost deficits continue to grow. For my dissertation project, I examine the success of contemporary Chinese-American operas as an important exception to this business model. By examining three cases of opera productions through an interdisciplinary approach that combines business and the arts, I will construct an alternative business model for the successful production of opera.

Cartilage injuries represent a leading cause of disability among adults, profoundly impacting the lives of those afflicted and represent a huge socioeconomic burden, yet effective therapies remain elusive. Native cartilage cells, chondrocytes, are an attractive cell for cartilage repair, but are very limited in supply. I aim to harness fat-derived adult stem cells in conjunction with chondrocytes to enhance cartilage formation, minimizing the chondrocytes required. I further seek to discover the molecular mechanisms that lead to enhanced cartilage formation during co-culture. Finally, I will use novel biomaterials to support neocartilage formation, ultimately serving as a graft to repair cartilage defects.
Artemis SeaforD  
Jack and Anita Saltz Fellow  
Political Science

We are currently experiencing an unprecedented shift in public opinion on the issue of sexual assault, with strong voices demanding higher regulation, stricter policies, and a broader understanding of what counts as sexual assault. At the same time, the rapid change in college policies and, to a lesser extent, criminal law standards, has given rise to backlash. Critics condemn new policies as too broad and restrictive. My project aims to contribute to this debate by systematically examining the problem of sexual assault, and putting forward a theory to govern its regulation. To do so, I will draw upon insights and methodological tools from social science, psychology, philosophy, sociology, and law. Each of these disciplinary perspectives captures an aspect of what is problematic with sexual assault, and therefore holds a piece of the puzzle of how we should address it. My objective is to bridge these various disciplinary perspectives and create a comprehensive, multi-dimensional understanding of what is wrong with sexual assault, and a corresponding approach on how to address it to guide both criminal law and sub-state mechanisms, such as campus policies.

Handuo Shi  
Rosenberg Ach Family Fellow, Bio-X SIGF  
Bioengineering

Bacterial cells constantly face multiple stresses, such as starvation, antibiotics, and competition between individual cells. Understanding how cells survive under stressed conditions (and grow again when the environment becomes favorable) is critical for controlling latent bacterial infections and lessening disease burden. To address these issues, I have been applying interdisciplinary approaches to tease apart the interaction between bacterial cells and the environment, from single genes to genome-level libraries, studying behaviors from individual cells to bacterial populations. My research will reveal how bacterial cells, both individually and as a consortium, respond to stressed conditions and has potential applications in translational medicine.
Global climate change poses a major threat to communities worldwide through increased severity and frequency of natural hazards and reduced access to critical resources such as food and water. Preventing or limiting these harms will require adaptation by actors at all levels of society. The ability of actors and systems to adapt is called adaptive capacity, and building this capacity would substantially reduce vulnerability and, ultimately, prevent harm. Recognizing this potential, research on adaptive capacity has drawn interest from a wide range of disciplines, and international development practitioners have begun efforts to build capacity. However, efforts have been stymied by lack of agreement on exactly what adaptive capacity is or how to assess and build it. My dissertation combines digital humanities tools and vulnerability studies to provide new methods to define, assess, and apply adaptive capacity to build communities that are better able to prepare for and respond to climate change.

Language is a multilayered, multimodal system, in which we express not only propositional content, but also social meanings having to do with emotion, intent, and power. These meanings arise in the context of large-scale social structures, but take shape moment-to-moment in words, gestures, intonation, and implication. In my research, I aim to explore both of these aspects of social meaning, combining computational and sociolinguistic analysis on large datasets across diverse domains. My projects consider questions such as the connection between body movements and vocal acoustics in one-on-one interactions, how police officers speak differently to community members based on race, and how linguistic framing in the media can express implicit biases. I hope that this work can help us to learn about the linguistic roots of conflict and misunderstanding in our social world.
Natural gas leaks waste money, reduce energy availability, and result in both local air quality and global climate impacts. Current EPA estimates suggest that about 1.5% of the natural gas produced in the United States is lost in leaks, while recent studies suggest that potential emissions from the gas system may be higher.

We propose an interdisciplinary project that will harness the potential for computer science advances, like the knowledge of machine learning, deep learning and computer vision, to allow for rapid automatic detection of methane leaks and estimation of their size. This project will join industry-standard equipment to pollution dispersion models for rapid impact assessment for real-world leaks. We will then perform economic and policy analysis to analyze benefits of automating pollution detection.

My research diagnoses opportunities and challenges that society faces from privatizing and marketing its most precious natural resource: water. Water markets receive praise for garnering private investment in an era of constrained government budgets and improving economic efficiency, cooperation, and adaptive capacity. Yet water markets face criticisms that they enable environmental degradation, harm communities, and deprive individuals of basic supplies. As governments increasingly look to water markets to adapt to changing demands and supplies, I aim to paint a nuanced picture of when, where, and how water markets can help. My research studies environmental water marketing—buying existing, consumptive water rights and using them to protect and restore environmental streamflows—in the Colorado River Basin under drought and dry climate change. My work blends hydrologic modeling and legal analysis with insights from ecology, operations research, economics, and finance and aims to identify optimal legal and conservation planning strategies for environmental water marketing.
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2015

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Amy Pickering, *Presidential Fellow*
Maryanna Rogers, *Presidential Fellow*
Karen Thompson, *Presidential Fellow*
Maria Perez Zurita, *Presidential Fellow*

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