SMART 2019 GRADUATE MENTOR RESEARCH PROJECTS

For the SMART 2019 Program, there are a total of eight graduate mentor research projects from a variety of disciplines. This page provides an overview in table form of these research projects; more detailed descriptions follow this overview.

ACADEMIC PROGRAM	RESEARCH PROJECT TITLE	GRADUATE MENTOR
ANTHROPOLOGY/ ARCHAEOLOGY	The Hydrological Legacy of Sugar Planting in St. Croix, U.S. Virgin Islands	Benjamin D. Siegel
ARCHITECTURE AND BUILDING SCIENCE/NEW MEDIA	Perception of Spatial Design in Healthcare Facilities Using an Immersive Experience	Haripriya Sathyanarayanan
ARCHITECTURE AND BUILDING SCIENCE/NEW MEDIA	Connected Smart Hospitals Enabled by Visible Light Communication	Haripriya Sathyanarayanan
CIVIL AND ENVIRONMENTAL ENGINEERING	Laboratory Earthquakes: Direct Observation of Stick-Slip Fault Behavior	Jes Parker
ENVIRONMENTAL SCIENCE, POLICY, AND MANAGEMENT	Understanding Defensive Strategies: The Consequences of Losing Legs in Daddy Long-Legs	Ignacio Escalante
MECHANICAL ENGINEERING	Modeling and Testing of Eco-friendly Piezoelectret Sensor for Anthropocentric Pressure Measurements	Neil Ramirez
SCIENCE EDUCATION	Undergraduate Research in Biology Built on Students' Own Funds of Knowledge	Laleh Coté
SOCIOLOGY	"I Regret To Inform You That Your Private Information Has Been Compromised"	Naniette H. Coleman

SMART 2019 ANTHROPOLOGY/ARCHAEOLOGY PROJECT

The Hydrological Legacy of Sugar Planting in St. Croix, U.S. Virgin Islands (Benjamin D. Siegel)

Present day residents of St. Croix (Crucians), many of whom are descendants of enslaved Africans, regularly endure droughts and lack reliable and safe drinking water. Moreover, several of the island's natural aquafers have become contaminated with salt water, while siltation from the island's eroding landmass continues to harm nearby critical coral reef ecosystems. More recently, it has also been made clear that this small Caribbean island is highly susceptible to intense tropical weather events, with many Crucians today still suffering from the extensive water damage caused by the two category 5 Hurricanes, Irma and Maria, that hit the U.S. Virgin Islands in the summer of 2017. Using multiple lines of evidence from the fields of history, archaeology, hydrology, and paleolimonology, my research will test the hypothesis that the rapid and unsustainable intensification of St. Croix's sugar-based monoculture between the 17th and 19th centuries led to the island's currently observable lack of water hazard resilience.

This summer I will work with a UC Berkeley undergraduate to identify and synthesize historical documents, maps, aerial photographs, paleoenvironmental data, and spatial data to characterize the water management practices in use on colonial period sugar plantations in St. Croix, and quantify their impacts to the island's environment. Research will focus specifically on Danish and potentially British plantations that were built on the island during the 18th century, and will include the examination of primary resources such as planter and merchant memoirs, import and export records, precipitation records, and land use maps. It is important that the undergraduate comes in with an understanding of, or interest in, advanced historical research, possesses strong written and oral communication skills, and has an eagerness to learn how to better extract meaningful data from 18th century and contemporary (secondary) sources. Through this directed research assignment the undergraduate will gain invaluable archival experience exploring and working with digital records from the British Library in London, England, the US Library of Congress in Washington, D.C., and the Danish National Archives (Rigsarkivet) in Copenhagen, Denmark. The ability to read Danish or any other Scandinavian language would be a benefit but is not required for the position. GIS skills would also be of use to the applicant, but again are not required. It is my intention that the undergraduate student will leave this summer assignment capable of conducting independent and intensive historical and archival research. (No travel is required as research materials will be available in digital format.)

SMART 2019 ARCHITECTURE AND BUILDING SCIENCE/NEW MEDIA PROJECTS

Architecture, Building Science, and New Media Project 1: Perception of Spatial Design in Healthcare Facilities Using an Immersive Experience (Haripriya Sathyanarayanan)

Are you excited by Virtual Reality (VR) and Immersive Experiences (IE)? Do you like 3D modeling and simulations of the built environment? How about preparing content to set up a lab experiment involving aspects from all of these?

Virtual Reality (VR) is an interactive three-dimensional computer-generated experience that takes place within a simulated environment that can be explored through a variety of peripheral devices such as VR headsets. We will use an evidence-based design (EBD) approach, of basing decisions about the built environment on credible research to achieve the best possible outcomes, to test spatial experience in-virtuo.

This study is a part of my PhD research and is proposed as a preliminary study on spatial perception and design. The purpose of the study is to assess perception, behaviour and user experience in-virtuo in comparison to in-vivo to understand any relationship between spatial design and experience, and how they differ between a physical and virtual space.

Any previous training in the skills listed below will be beneficial, but not mandatory. I hope that by working on this project, a motivated and enthusiastic student will gain experience and training in creating 3D models (Rhino), developing relevant content for VR (Unity 3D), preparing survey questionnaires (Qualtrics) as well as experience and training in software for data visualizations, presentation and analysis (Excel, Powerpoint, Tableau, R, etc.). Ideally the students should have some experience in 3D modeling in Rhino, and be prepared for a steep learning curve in VR content development and survey design. There will be some work in reviewing relevant literature in this domain. Depending on the student's skillsets and interest we will choose to focus on the literature, modeling, VR content (interface, scripting, navigation) and/or survey design. Based on the development of the project and experience, the mentee can choose to be involved at a later stage during the actual lab experiments and analysis.

Architecture, Building Science, and New Media Project 2: Connected Smart Hospitals Enabled by Visible Light Communication (Haripriya Sathyanarayanan)

What makes a "smart" building "smart"? Does a "smart" building or space trigger behavioural changes in users and their interactions with the space?

Transformation in health and medicine calls for innovation and integration of information science and engineering approaches to revolutionize healthcare delivery systems, including high-performance wireless communication and sensing technologies. This study is part of an NSF-funded project and will focus on developing event-based behavioural models to simulate building-user interactions in hospital settings, to predict human behaviour in a hospital and optimize design.

Any previous training in the skills listed below will be beneficial, but not mandatory. I hope that by working on this project, a motivated and enthusiastic student will gain experience and training ~~in~~ working in Unity 3D platform (interface, scripting, navigation), and in developing algorithms for the simulations. The student is expected to work on various scenarios for the simulations. This will include inputs for the smart space ontology, space characteristics, schedule of activities in the space and profiles of different users in the space. The project may include modeling of architectural layouts of the hospitals for the scenarios, including data input using the event modeling language and activating the model through a simulation engine (Unity 3D) based on the progress. Depending on the student's skillsets, interests and project progress, the focus may be on generating scenarios or specific data for input. The project may include studies in hospital environment if we do manage to get permissions for the study.

SMART 2019 CIVIL AND ENVIRONMENTAL ENGINEERING PROJECT

Laboratory Earthquakes: Direct Observation of Stick-Slip Fault Behavior (Jes Parker)

Laboratory seismology uses a scale-model approach to complement the wealth of research on in situ earthquakes that cannot be observed directly. A simple mechanical system applies shear stress to two blocks with a roughened interface, such that it produces stick-slip behavior with energy signatures matching in situ earthquakes. Lab scale seismic sensors allow us to apply typical seismological analyses. Additional instruments provide measurements not available in the field, which are used to expand our understanding of the underlying processes as well as the results and limits of the seismological methods.

There are two supporting projects available, depending on student interests and skills:

- The experiment uses a transparent material which allows direct visual observation of the slipping interface (the fault) using a high speed camera. The student would be responsible for setting up the camera system and developing a method of analyzing the video recordings, preferably using Python or MATLAB. Programming experience is not required but would allow the student to progress further in the analysis.

- A student with experience in any aspect of seismology, signal processing, or scientific computing would have the opportunity to conduct and analyze an experiment in tuning the fault. After receiving the necessary training, they would investigate and report on the basic characteristics of the nano-quakes produced under different loading conditions.

Through either of the topics, the undergraduate researcher will gain experience in mechanical lab skills and scientific computing. They will be expected to develop some independence over the ten-week period, while meeting at least weekly with the graduate mentor, and produce a final project summarizing the work and results.

SMART 2019 ENVIRONMENTAL SCIENCE, POLICY, AND MANAGEMENT PROJECT

Understanding Defensive Strategies: The Consequences of Losing Legs in Daddy Long-Legs (Ignacio Escalante)

One crucial topic in ecology is understanding how animals respond to environmental pressures. My research aims to study the behavioral ecology of animal defenses in an evolutionary biology framework. Specifically, the project focuses on voluntary release of legs by arachnids. Although beneficial in the short term, this behavior can carry important negative consequences in the locomotion, physiology, and behavior of animals.

Daddy long-legs are ideal for this research because of their unique morphology and behavior. Their accessibility also offers the possibility of performing extensive fieldwork and laboratory experiments in the Berkeley area.

Any previous training in the skills listed below will be beneficial, but it is not required. We hope that by joining the Elias lab a motivated and enthusiastic student will gain experience and training in video visualization and editing software (Adobe Premiere, Quicktime), coding tools (R, Matlab, Mathematica), as well as experience and training in software for data visualization, presentation, and analysis (R, Excel, PowerPoint).

This research also offers the possibility to collaborate with other labs on campus and conduct lab work dealing with chemical ecology or energetics of locomotion. Studying the above mentioned topics requires patience and meticulous work when doing animal care, taking morphological measures, operating lab equipment, or observing behaviors.

SMART 2019 MECHANICAL ENGINEERING PROJECT

Modeling and Testing of Eco-friendly Piezoelectret Sensor for Anthropocentric Pressure Measurements (Neil Ramirez)

The ability to measure vibrations is a vital engineering problem. From measuring pulse for health diagnostics to sensing pressure on a touch screen for a smart phone, the applications vary far and wide. In our group we study the use of polymer-based devices called piezoelectrets to measure pressure signals for a variety of applications. Our microfabricated polymer approach yields superior flexibility, piezoelectric coefficients, and cost-effectiveness when compared to traditional ceramic material competitors. The devices themselves also vary in material composition and geometry depending on the application.

In this project we explore the potential of using environmentally friendly materials for the fabrication of a piezoelectret pressure sensor without compromising performance. The undergraduate researcher will be directly involved in synthesizing materials at the micro-scale by exploring thin-film production methods. The goal for the project is for the undergraduate researcher to synthesize their own materials leading to the fabrication of a working piezoelectret device. After fabrication, the undergraduate researcher will learn how to characterize the performance and structure of the device using electrical measurements and SEM imaging. As the researcher learns about the working mechanisms of the device, a computer-aided design (CAD) model and simulation will be created to optimize performance.

The fabrication requires knowledge of basic chemistry and material stress-strain relationship; all specific fabrication techniques will be taught during the program. The electrical measurements will require familiarity with Ohm's and Kirchhoff's laws, so basic physics knowledge is required. Data processing can be performed in a variety of platforms; however, Excel or MATLAB/Python knowledge is preferred. The modeling and simulation of the device will be done through SolidWorks and COMSOL: SolidWorks experience would be helpful but COMSOL can/will be learned during the program. The ideal applicant will be passionate about micro-scale fabrication and the opportunity to design/create/validate through the engineering process.

SMART 2019 SCIENCE EDUCATION PROJECT

Undergraduate Research in Biology Built on Students' Own Funds of Knowledge (Laleh Coté)

My overarching research project is to develop, implement, and assess a new model for undergraduate involvement in research, targeting first and near-first generation to college STEM majors who attend community colleges.

First generation to college students are only slightly underrepresented in terms of initial STEM enrollment, but much less likely to complete their degree. Near-first generation students are those who have a parent with a four-year degree, but have little to no knowledge about success in higher education in the U.S. (e.g., foster children, children of immigrants). Students from both of these groups often lack the social capital (e.g., role models) to gain access to professional experience in their field and may have other burdens (e.g., financial struggles, family commitments) upon entering college. This project is grounded in the culturally inclusive "Funds of Knowledge" framework that draws on the lived experiences students bring to research, and stands in opposition to the "deficit model" of education that focuses on what students from particular groups lack.

The first phase of this project involves learning about the experiences of students, STEM faculty, and scientists (collecting data through surveys and interviews), in order to develop an intervention to facilitate the "matching" process between students and scientists. Additionally, this information will be used to redesign the

traditional undergraduate research experience to allow students to a) work with researchers on an existing project to develop technical skills, b) use these skills to design their own research project in biology, and c) act as "science ambassadors" to share their research designs with members of their own community. Our hope is that cross talk between communities of scientists and nonscientists will inspire researchers to take on more projects that impact local communities and directly communicate with diverse groups about their efforts and findings.

Students interested in working on this project should have a strong interest and/or experience in science education, education, journalism, culture, writing, communication, or STEM/education outreach. This work may include the following: literature searches, scheduling logistics, writing, survey administration, in-person interviews, audio transcription, data analysis, and data visualization. Previous experience with science education is not required. If you attended a community college yourself, please do mention that in your application.

SMART 2019 SOCIOLOGY PROJECT

"I Regret To Inform You That Your Private Information Has Been Compromised" (Naniette H. Coleman)

Project Abstract: Privacy is one of the central issues of our time. All things being equal, we assume that most people prefer privacy; it is a foundational right enshrined in the "penumbras" of the 1st, 3rd, 4th, 5th, 9th, and 14th amendments of the U.S. constitution as well as in several state constitutions (including those of California, Massachusetts, and Washington) and the Universal Declaration of Human Rights. Despite our appreciation of privacy, police officers wear body cameras, customer loyalty programs track purchases, and the Transportation Safety Administration performs full body scans. This paradox illuminates the deep ambivalence in modern American society about privacy, and a largely untapped area of research in sociology. This research seeks to understand the deeper cultural logics inherent in shifting views on privacy in the modern world as well as the evolution of its meaning historically in the U.S. context.

Day-to-Day Tasks: (1) data entry (2) transcribing audio files of interviews (3) database searches (4) reviewing articles to determine relevant materials (5) managing and organizing files, (6) extracting general information about articles and interviews, (7) attending privacy-focused events and taking notes, and (8) assisting the supervisor with a bit of "public sociology" including information collection and dissemination on privacy, and planning and executing privacy focused event(s). Opportunities for different kinds of work will expand as the project progresses, and aspects of the project that the undergraduate is interested in will be prioritized when possible. Mentees will meet as a group weekly and will do group work occasionally.

Learning Outcomes: This is a valuable opportunity to get hands-on experience with the data collection process and insight into how data collection relates to the larger research agenda/goals. Are you still trying to figure out if graduate school is for you? If so, students can also expect to learn skills that are relevant and marketable outside of the research space. Students will meet weekly with the research supervisor and larger team in order to ask questions, workshop solutions, and discuss ongoing work and findings.

Qualifications: Students should be detail oriented, organized, and excited by/interested in learning more about research. This project is open to undergraduates in any year or major, and there are no course prerequisites. You will be trained in everything you are required to do. A passion for the topic of study is preferred but not required.

Off-Campus Research Site: Unless attending regular meetings with the supervisor and/or research group or any required program events/meetings, students may work anywhere they like.