UC Noyce Initiative

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2023 ANNUAL REPORT

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EXECUTIVE SUMMARY

The mission of the UC Noyce Initiative is to advance research collaborations in critical areas of digital technology and innovation to drive informed, ethical, and timely discovery for the public good. The Initiative is principally funded by the Robert N. Noyce Trust and brings together researchers from five UC campuses — Berkeley, Davis, Irvine, San Francisco, and Santa Barbara — by building community and awarding competitive grants initially focused in three key priority areas: Cybersecurity & Privacy, Computational Health and Quantum Computing.

Honoring the legacy of Robert N. Noyce, the Initiative made significant strides towards our mission in 2023. Researchers who previously received support from the Initiative continued to make important advancements on their projects and in training the next generation of research leaders. The impressive impact of the principal investigator driven research projects supported by the Initiative in each of the three thematic priority areas are highlighted throughout this report.

Building on the progress achieved in the initial years, in 2023, the Initiative launched a new award selection process coordinated across all five campuses. This unified approach better enables researchers on all Initiative campuses to undertake high-risk high-reward research to advance computational transformation. In the 2023 award cycle, the Initiative received 70 applications, of which 13 outstanding single and multi-campus awards were selected for support. The project summaries of the 2023 awards are provided in Appendix 1.

In addition, the Initiative began to promote a consistent and uniform public profile, reflected in a comprehensive new website that showcases all aspects of the Initiative, and already features numerous news highlights that demonstrate the success of Initiative awardees. The Initiative also engaged the Noyce Trust in several campus visits and hosted events to highlight the impressive initial impact of Initiative funded research. For example, on November 16, 2023, the Initiative celebrated the successful launch of the Ann S. Bowers Women's Brain Health Initiative that involves researchers from all five campuses - and beyond.

In the coming year, the Initiative will continue to expand its efforts with a focused set of research priorities and opportunities for engagement with and for the Initiative researchers.

INITIATIVE HIGHLIGHTS

UC Noyce Initiative researchers on all five campuses are utilizing the latest computational methods to identify innovative solutions to important grand challenges across the fields of health, quantum science, and cybersecurity and privacy. Supported researchers have made important strides in furthering their research, as reflected in their impressive publication record. Publications are a key metric in academic research and serve as an important peer review check-point. The **88 new publications** reported by the current cohort of researchers speak to the high quality of their work.

Initiative researchers have also already leveraged **over $16.7 million in additional award funds** that expand on the seed funding provided by the Initiative. Both publications and follow-on funding will help build the name recognition associated with the UC Noyce Initiative.

The **71 principal investigators** involved in these projects are leaders in their fields, whose research will likely influence tangible societal impacts. Importantly, these projects also engaged **93 students** in research, and allowed **24 postdoctoral scholars** to gain more research experience as they evolve into independent researchers. Engaging students and early-career investigators is critical to building a strong pipeline of future researchers who will drive forward much needed computational advances to help address the most pressing societal challenges.

Noyce Initiative by the Numbers

$16.7M+
in Leveraged Funds

88
Publications

71
Principal Investigators

117
Students & Postdocs

2023 MILESTONES

- **FEB 2023** ▶ FORUMULATION OF GRAND CHALLENGES TO BE ADDRESSED IN 2023 RFP
- **SPRING 2023** ▶ EXECUTIVE COMMITTEE AND LEADERSHIP MEETINGS
- **JUN 14, 2023** ▶ 2023 RFP RELEASED
- **JUNE 27, 2024** ▶ INFORMATIONAL WEBINAR
- **SUMMER 2023** ▶ PROPOSAL EVALUATION
- **SEP 18, 2023** ▶ 2023 AWARDS SELECTED
- **FALL 2023** ▶ EXECUTIVE COMMITTEE AND LEADERSHIP MEETINGS
- **OCT 2, 2023** ▶ LAUCH OF INITIATIVE WEBSITE
- **OCT 17, 2023** ▶ RESEARCHERS PROVIDE ANNUAL RPOGRESS REPORTS
- **NOV 16, 2023** ▶ ANN S. BOWERS WOMENS BRAIN HEALTH EVENT AT TECH INTERACTIVE, SAN JOSE
- **DEC 18, 2023** ▶ ANNUAL REPORT PUBLISHED

"Innovation is everything. When you're on the forefront, you can see what the next innovation needs to be."

– Robert N. Noyce

Robert N. Noyce was one of the pivotal visionaries of the 20th century. He invented the integrated circuit, more commonly known as the microchip, and then co-founded both Fairchild Semiconductor and Intel. This work and the industry he helped shape, paved the path to the personal computer revolution, and gave Silicon Valley its name. Throughout his life, Dr. Noyce believed deeply that we "... make sure we are preparing our next generation to flourish in a high-tech age."

RESEARCH HIGHLIGHTS

Initiative researchers within the computational health area are at the forefront of harnessing computational and data analytic technology to improve the diagnostic, therapeutic, and preventative options available for a wide range of health conditions. From developing cellular therapies to treat cancer and improving diagnostic capabilities in emergency departments, to advancing our understanding of neurodegenerative diseases like Alzheimer's, all of the supported research gets us closer to improving critical health outcomes.

*Ann, a research participant in a study of speech neuroprostheses led by UCSF's Edward Chang, is connected to computers that translate her brain signals into the speech and facial movements of an avatar. UC Noyce researcher **Gopala Anumanchipalli** (UCB) is part of this innovative research team.*

***Nina Miolane** (UCSB) shares her methods to analyze medical imaging data*

The Ann S. Bowers Women's Brain Health Initiative, led by **Emily Jacobs** (UCSB) with collaborators at other UC Noyce Initiative campuses, advances the study of women's brain health through a collaborative brain imaging consortium. The investigators maintain that most of what we know about health and disease centers on the male body. More specifically, neuroscientists overlook aspects of the human condition relevant to half of the global population (e.g. the menstrual cycle, the pill, pregnancy, menopause). By integrating research activities across campuses and bringing together world-class expertise in neuroimaging, computer science/AI and healthcare, the University of California is in a unique position to lead these efforts in partnership with institutions around the world. This consortium utilizes vast data sets across its partner UC campuses, in order to help address questions including, how do we explain that close to 70% of Alzheimer's patients are women, or what underlies postpartum depression. One exciting accomplishment to date includes generating the first atlas of the human brain across pregnancy. The consortium has already secured an additional $1.1 million in funding from NSF and others to leverage seed funding from the UC Noyce Initiative.

RESEARCH HIGHLIGHTS

Julien Cobert (UCSF) is working to see how doctors' notes in patients' charts can **improve palliative care decisions.** He reports that "this funding has been transformational, helping create a largely novel area of research" that explores how the narratives of clinical notes may impact patient care. Additionally, Cobert notes that Initiative support allowed him "to **explore new directions and spin off a dozen projects from the original proposal**, forge unique collaborations (including with David Bamman at UC Berkeley), and build a team including statisticians, computational scientists, machine-learning experts, linguists, clinicians, and student mentees dedicated to answering cross-disciplinary questions. Noyce-derived preliminary data has also led to exciting funding opportunities."

"This funding has been transformational, helping create a largely novel area of research."
– Julien Cobert (UCSF)

Ziad Obermeyer (UCB) was recognized in 2023 as one of **Time Magazine's 100 most influential people in artificial intelligence.** This recognition was based on his Initiative supported research to improve the identification of likely high-risk sudden cardiac death through a single electrocardiogram.

Jing Shan (UCSF) filed a patent application related to her research on machine learning-enabled determination of diagnostic codes for glaucoma, a leading cause of blindness worldwide. Such advances will enable **improved and earlier detection and treatment for glaucoma to hopefully retain vision longer.**

RESEARCH HIGHLIGHTS

Bin Yu's (UCB) research to develop clinical decision instruments to improve clinicians' diagnostic capabilities in emergency departments was inspired by a personal visit to the emergency room. After seeing first hand how proposed diagnostics and treatments were dependent on the available data in each moment, Yu wanted to explore how she could improve how health data is analyzed. Currently, Yu is **developing algorithms that periodically scan children's medical records while they are in the ER to provide better insight into whether CT scan radiation exposure is worth the risk.**

"My goal isn't just to tackle one small problem at a time; it is to bring all sorts of skills and people together to create entirely new frameworks for analyzing data so we can arrive at trustworthy conclusions."

\- **Bin Yu** (UC Berkeley)

Nhat Tran, a UCSF Ph.D. student, noted that "funding from the **Noyce Initiative allowed me to be more ambitious in my approach**, which led to better results in my projects. **I'm also a lot more confident about my role as a researcher** and an engineer/innovator, which will benefit me greatly in my future career." Researchers in this area also report how meaningful collaboration opportunities have been for their research. **Matthew Hancock,** another UCSF Ph.D. student, stressed that the support allowed him **to engage not with faculty across the UC system and provided an opportunity for his research to inform the work of another Initiative fellow.** Specifically, Hancock noted "I connected with another fellowship recipient attempting to program human cells to kill solid tumors who can use my method to better understand and design the molecular sensors that discriminate between cancer and non-cancer cells."

CURRENT AWARDEES

Fahim Anjum (UCSF) is applying computational data analytics to adaptive deep brain stimulation data to improve sleep quality for individuals with Parkinson's disease, thus helping reduce symptom and disease progression.

Gopala Anumanchipalli (UCB) utilizes computational models of spoken language to develop more effective and personalized communication tools for individuals who are unable to speak, including paralyzed individuals, as well as to improve the diagnosis and rehabilitation of speech disorders.

Elena Agapie (UCI) and colleagues organized a series of meetings and workshops among faculty and graduate students at UCI in the areas of AI and Health Equity to lay the foundation for future research collaborations.

Hersh Bhargava (UCSF) is working with computational simulation methods to develop cellular therapies that one day could be used to treat cancer.

Sasha Binford (UCSF) and her collaborators are applying machine learning methodologies to predict delirium potential in hospital patients. By more accurately predicting which patients are at greater risk for delirium, and the subsequent negative side-effects, providers can act proactively to prevent delirium.

Chen-Nee Chuah (UCD), **Brittany Dugger** (UCD), **Peter Chang** (UCI), and **Michael Keiser** (UCSF) are developing an accessible deep learning framework for neuropathology and neuroradiology image analysis to aid deeper phenotyping of neurodegenerative (e.g. Alzheimer's and dementia) and cerebrovascular (e.g. stroke) diseases.

Julien Cobert (UCSF) is exploring how electronic health record notes written by intensive care unit physicians can be used to develop flags for palliative care or other interventions in critically ill patients.

Miguel Eckstein (UCSB) plans to develop a Computational Virtual Patient that can predict the perceptual capabilities of prosthetic vision to optimize prosthetic designs for individuals with irreversible vision loss.

Yoshimi Fukuoka (UCSF) aims to increase awareness and knowledge around the risk of heart disease in women through personalized messages delivered by an AI-driven chatbot.

Soheil Ghiasi (UCD) plans to pilot test a prototype of a fetal arterial blood oxygen saturation device among expectant mothers. This non-invasive technology could improve identification of fetal distress during labor and delivery.

Anu Manchikanti Gomez (UCB) will undertake a mixed methods study to describe the state of sexual and reproductive health misinformation among young people (ages 13-25) in the US.

Matthew Hancock (UCSF) is using molecular simulations to understand the states and structures proteins undergo during various biological conditions to gain insight into the molecular origins of diseases like cancer or to improve the identification of potential therapeutic targets.

Nilah Ioannidis (UCB) is working to improve genome sequencing models used in precision health to determine drug dosages and disease risks by accounting for genetic variation between individuals.

CURRENT AWARDEES

Emily Jacobs (UCSB), **Nina Miolane** (UCSB), **Mark D'Esposito**, (UCB), **Craig Stark** (UCI) will build a population-level brain imaging database that harnesses the computational power of deep learning and AI to transform the study of women's brain health across the life course. This will allow researchers to better understand how things like menopause, pregnancy, the menstrual cycle, and hormone-based medications influence the brain.

Geoffrey Manley (UCSF), **Lara Zimmerman** (UCD), and **Kristofer Bouchard** (UCB) aim to analyze brain-imaging data using computer vision technologies and machine learning to improve traumatic brain injury classification and outcome prediction. The tools developed will be applicable to other diseases as well.

Ziad Obermeyer (UCB) utilizes artificial intelligence to improve medical diagnostics, with the current focus on how electrocardiograms can identify patients at high risk for sudden cardiac death before it occurs so they can be targeted with preventative interventions.

Isabel Rodriguez-Barraquer (UCSF) aims to develop a framework for joint inference of local infectious disease transmission dynamics from multiple data sources (genomic, case, wastewater, and seroprevalence). This knowledge could inform best practices for managing future pandemics.

Jonathon Schofield (UCD) aims to reduce barriers to and improve the capabilities of bionic prostheses using machine learning and leveraging surgical advances.

Sanjit Seshia (UCB), **Yasser Shoukry** (UCI), and **Cathra Halabi** (UCSF) will create a personalized home-based rehabilitation platform using the latest advancements in Mixed Reality technology to enable clinicians to precisely tailor patient assessments and interventions.

Jing Shan (UCSF) is exploring how artificial intelligence can be used to increase the predictive accuracy of glaucoma diagnostics and management to expand access to vision-saving therapies.

Yun Song (UCB), **Steven Brenner** (UCB/UCSF), and **Sook Wah Yee** (UCSF) aim to develop models to predict the impact of mutations of proteins known to be of clinical importance. This enhanced predictive ability can lead to more rapid diagnoses, as well as more tailored and efficient therapeutic options based on a patient's genetic makeup.

Geoffrey Tison (UCSF) will design medical AI algorithms by establishing a novel, multimodal, physiologically focused deep neural networks architecture optimized for medical tasks. This will then be validated using heart failure data. This could allow for earlier and more accurate heart failure diagnosis.

Nhat "Nate" Tran (UCSF) is developing a tool to predict how tumor cells progress through brain tissue in individuals with glioblastoma, an aggressive form of brain tumor, to allow clinicians to better tailor radiotherapy and surgical interventions.

Jaeyun "Jane" Wang (UCSF) aims to develop an artificial intelligence-based model to predict whether a pancreas tumor can be removed successfully via surgery.

Bin Yu (UCB) extends machine learning algorithms to develop clinical decision instruments that can be used to improve clinicians' diagnostic capabilities and potentially patient outcomes.

RESEARCH HIGHLIGHTS

The field of quantum science is rapidly evolving, with each new advance moving us closer to computational and engineering possibilities only previously imaginable. Initiative researchers working to advance quantum science, either through developing new algorithms, developing error-correction codes, or innovating the design of quantum computers all made important progress this year.

"This award gave us the freedom to explore research that we would otherwise have been unable to explore. It also fostered a new collaboration with Marina Radulaski's group at UC Davis."

- Irfan Siddiqi (UC Berkeley)

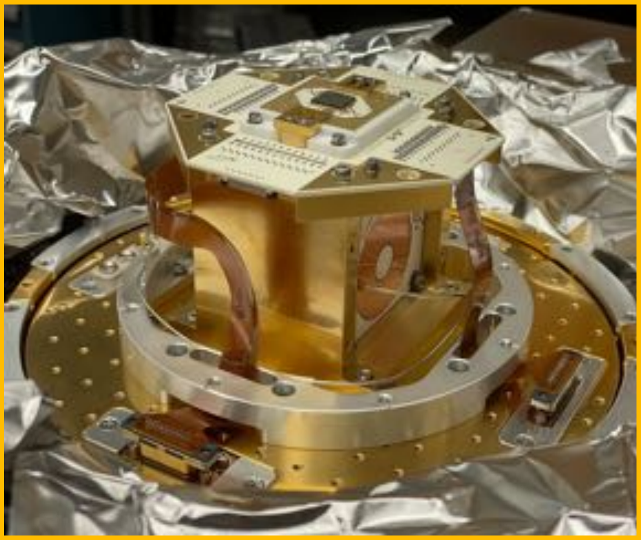
Irfan Siddiqi *with his research team in his quantum computing lab at UC Berkeley.*

Quantum Photonics for Secure Communications

Quantum photonics – the sophisticated production and manipulation of light at a fundamental level – is a key enabling technology for next-generation secure communication. However, simulation of many important elements of quantum photonics is challenging for traditional computers, creating significant barriers to developing even small-scale photonic devices. This collaborative project brings together the quantum photonics expertise of **Marina Radulaski** at UC Davis with the quantum computing expertise of **Irfan Siddiqi** at UC Berkeley to explore an innovative new approach to this problem – simulation of photonics systems using purpose-built quantum processors that can overcome the computational limitations of traditional computers. The result will be a **unique and robust platform for the design of quantum photonic devices.** Their cutting-edge research is shifting the limits of quantum computing and has already received a $300,000 collaborative award from another funder to continue and expand their research project.

RESEARCH HIGHLIGHTS

Quantum error-correction is vital for scalable quantum computing. **Venkatesan Guruswami** (UCB) is applying his deep experience in classical coding to quantum error-correcting, a new area of research for him. He constructed codes that can locally recover any message qubit -- which might be critical for quantum data storage. He has already published two papers on his research.



The cryogenic ion trapping system used by Andrew Jayich (UCSB)

Andrew Jayich (UCSB) and **Hartmut Haeffner** (UCB) used novel 3D printing methods to develop 3D ion traps that can be used to increase the speed and reliability of ion trap quantum computers. They were able to trap the first ion in a horizontal 3D-printed ion trap within a cryogenic system, which proves that their technology can work at extremely low temperatures. Such advancements might have implications on atomic clocks and mass spectrometry.

CURRENT AWARDEES

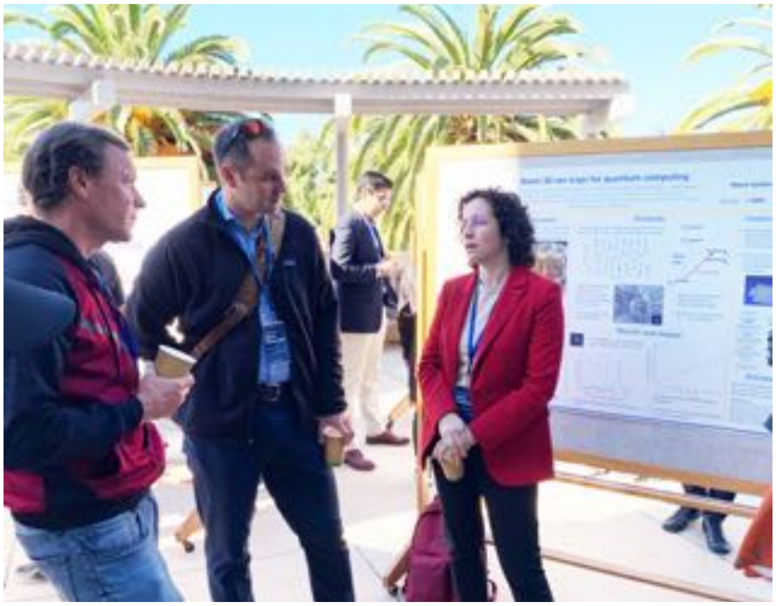
Venkatesan Guruswami (UCB) aims to address current challenges in quantum error-correction by identifying new error-correcting codes and then exploring their downstream impacts.

Andrew Jayich (UCSB) and **Hartmut Haeffner** (UCB) used novel 3D printing methods to develop 3D ion traps that can be used to increase the speed and reliability of ion trap quantum computers. Such advancements might have implications on atomic clocks and mass spectrometry.

Marina Radulaski (UCD) and **Irfan Siddiqi** (UCB) are exploring if superconducting quantum computers can become a tool for designing analog quantum devices in photonic platforms.

Irfan Siddiqi (UCB) is designing modular quantum processors which could increase the processing speed of quantum computers and someday may lead to the development of inexpensive, large-scale quantum computers.

Birgitta Whaley (UCB) is exploring how quantum algorithms might be used to implement large scale computational problems in fields like chemical engineering and chemical physics.



Andrew Jayich (center) and Marina Radulaski (right) discuss the latest in quantum science at the UC Noyce Symposium at UC Santa Barbara.

RESEARCH HIGHLIGHTS

Initiative researchers are working to improve data and network security while protecting data privacy across a variety of systems and platforms by harnessing the transformative power of artificial intelligence and machine learning. The supported research in this space currently applies to a wide range of domains, including financial institutions lending practices, supply chain vulnerabilities, improving human-AI interaction, social media platforms, and network threat detection.

***Dawn Song**, co-founder of Ensighta and Oasis Labs*

Cybersecurity Research in ACTION

UC Noyce Initiative support for UC Berkeley researchers Dawn Song and David Wagner along with partners at UC Santa Barbara and several other universities, resulted in the successful establishment of the **$20 million AI Institute for Agent-based Cyber Threat Intelligence and Operation (ACTION)** at UC Santa Barbara in 2023. Supported by the National Science Foundation, the new Institute seeks to change the way mission-critical systems are protected against sophisticated, ever-changing security threats.

Support from the Noyce Initiative was critical with two individual awards made to Dawn Song and David Wagner in July 2022 and a $1M multi-campus award made in October 2023 to David Wagner and collaborators at UC Davis and UC Santa Barbara, including Christopher Kruegel (UCSB), who serves on the ACTION executive committee. The new multi-campus award focuses on building tools to detect network security vulnerabilities before they can be exploited. The initial UC Noyce Initiative investments in innovative and critical research in the area of cybersecurity has **great promise for applications in industry and government agencies**. Dawn Song is the co-founder of prominent cybersecurity companies, Ensighta (acquired by FireEye Inc.) and Oasis Labs that ensure that the research finds immediate and broad practical application in the marketplace.

RESEARCH HIGHLIGHTS


Researchers Mark Steyvers and Miguel Eckstein

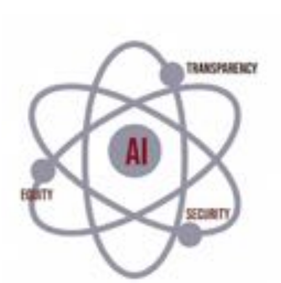
A new collaboration between **Mark Steyvers** (UCI) and **Miguel Eckstein's** (UCSB) focuses on creating new human mind inspired solutions for improving AI approaches to navigation, imagination, planning and reasoning. They explore **AI metacognition, or how AI can assess its own limitations** and then communicate those limitations to humans. Their research has already produced 21 publications.

"This collaboration led to imaginative new approaches to understand human and AI interaction."
-Mark Steyvers (UC Irvine) and Miguel Eckstein (UC Santa Barbara)

Chen-Nee Chuah in her office at UC Davis

Chen-Nee Chuah (UCD) and colleagues uncovered two new vulnerabilities associated with deploying deep neural networks on edge devices, which are the entry points of network data. Knowing the vulnerabilities allows for new security measures to be developed to protect the networks.

Zubair Shafiq (UCD), **Athina Markopoulou** (UCI), and **Gene Tsudik** (UCI) uncovered that user voice commands to Amazon's Alexa were used to inform ad targeting, which **prompted Amazon to update its disclosures.**



The training program developed by **Sky Zhang** (UCI) aimed at increasing knowledge around AI and machine learning was used to train members of the **UC-systemwide Presidential Working Group on AI.**

CURRENT AWARDEES

Swethaa Ballakrishnen (UCI) explored through a multidisciplinary approach how digital AI-mediated work will transform the work women do in India.

Chen-Nee Chuah (UCD), **Zubair Shafiq** (UCD), and **Houman Homayoun** (UCD) are working to identify vulnerabilities of IoTs and edge devices that run AI and ML enabled user applications (e.g. smart health applications) so that they can then develop defenses against potential attacks to protect the privacy of users.

Hany Farid (UCB) aims to develop a series of cyber-defenses to detect AI-generated images, audio, and video to combate disinformation and deep fakes.

Shafi Goldwasser (UCB) through the Simons Institute for the Theory for Computing will organize a research program on cryptography, focusing on obfuscation, secure systems, and secure computation.

Matthew Harding (UCI) is exploring how the use of AI may lead to biased lending decisions at financial institutions and is developing models to aid in more optimal loan decisions.

Houman Homayoun (UCD) aims to develop security analysis tools for detecting vulnerabilities to supply chain cyber attacks (stealthy hardware or software attacks that occur early on in a product's lifetime) that can then be mitigated.

Aneeth Kaur Hundle (UCI) takes up ethnographic methods in this collaborative research project to explore the effects of AI and machine learning on social inclusion and exclusion in four different transnational and local contexts.

Javad Lavaei (UCB) plans to use AI and machine learning to develop cyberattack detection algorithms for the US power grid.

Adeline Nyamathi (UCI) aims to design and validate an emotionally intelligent robot that mitigates agitation among persons experiencing moderate to severe dementia.

Amir Rahmani (UCI) will develop AI models that can safeguard patient bio-signal data, like ECGs, in a manner that both protects patient privacy, while also allowing the de-identified biosignal data to be used for population-level analysis to improve health services.

Zubair Shafiq (UCD) is working to understand how the algorithms used by social media platforms to offer users recommendations for viewing might be reinforcing biases, and then to test a "de-biasing" intervention.

Zubair Shafiq (UCD), **Athina Markopoulou** (UCI), and **Gene Tsudik** (UCI) aim to develop novel auditing tools, using a combination of technological and policy approaches, to evaluate compliance to new and existing data privacy laws by consumers and regulators. This project hopes to improve transparency around what personal data is collected online, on mobile apps, and devices.

Dawn Song (UCB) aims to develop distributed privacy-preserving cybersecurity learning systems. This research will boost the development of collaborative cyber threat intelligence, cross-silo fraud detection, and resilient malware and spam detection.

Mark Steyvers (UCI) and **Miguel Eckstein** (UCSB) are leveraging an interdisciplinary research approach that aims to address the challenges of human-AI interaction to make them more effective using empirical and theoretical approaches.

David Wagner (UCB) is working to detect network cybersecurity threats faster by using machine learning to characterize typing patterns of legitimate users.

CURRENT AWARDEES

David Wagner (UCB), **Hao Chen** (UCD), and **Christopher Kruegel** (UCSB) are developing improved methods for cybersecurity by building off recent advances in large language models. This research could help reduce security breaches as well as enable smaller companies to have more effective security practices at a lower cost.

Sky Zhang (UCI) and a team of faculty, developed an online training program to increase senior-level leaders' knowledge of AI and machine learning.

2023 AWARD SELECTION PROCESS

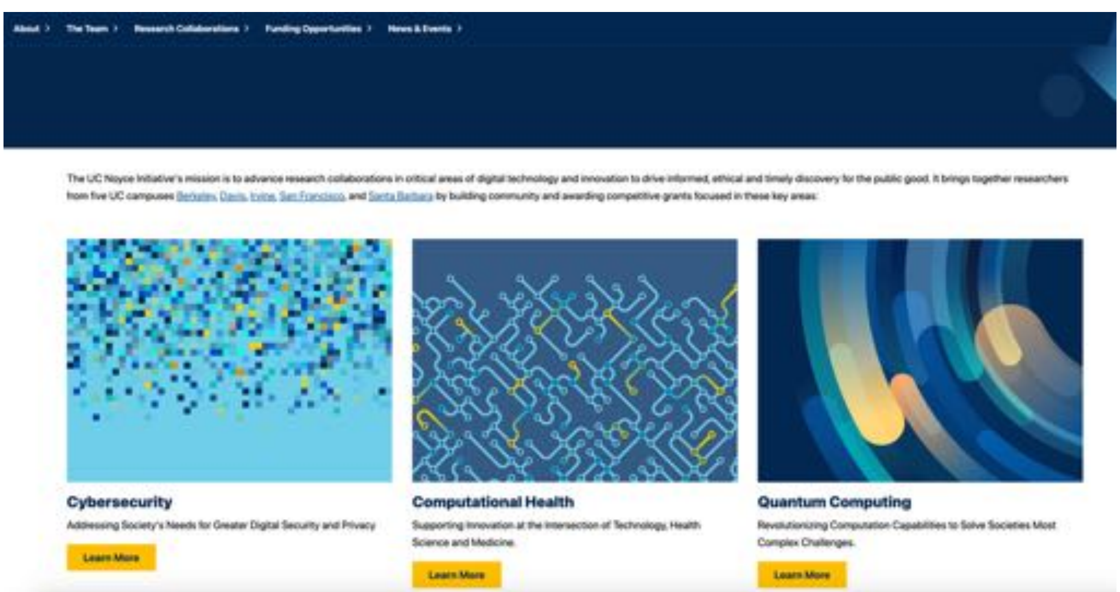
UC Noyce Initiative awardees share their research with each other and make new connections

The UC Noyce Initiative 2023 Request for Proposals (RFP) was released on June 14, 2023 and circulated widely at each Initiative campus to ensure eligible and interested researchers were aware of and had access to the application materials. The RFP is provided in Appendix 2. We held an informational webinar on June 27, 2023 where researchers could ask questions about the application process. To guide applicants, a supplemental frequently asked questions document included the webinar recording and was regularly updated with responses to applicant questions.

The Initiative received a wealth of applications from highly qualified applicants by the August 15, 2023 application deadline. These were evaluated based on their scientific merit and promise for collaboration. The peer review process resulted in the selection of 13 applications (2 multi-campus and 11 single campus) proposals for support.

INITIATIVE WEBSITE

On October 2, 2023, the Initiative website (https://ucnoyce.org) went live. The creation of the website was a collaborative effort, with all Initiative campuses providing materials, guidance, and feedback to the website developer. This website will continue to be the primary source for all information dissemination related to new RFP processes, highlighting current and past awardees, Initiative events, and achievements of supported researchers. The website will also promote news stories that highlight the work of Initiative supported research.



NOYCE RESEARCHERS IN THE NEWS

Throughout 2023 Noyce Initiative researchers were prominently featured in the news. Selected highlights in reverse chronological order include:

Emily Jacobs (UCSB) published an op-ed in Nature on November 21, 2023 calling attention to the severe neglect of women's brain health from puberty through to pregnancy and menopause.

Hartmut Haeffner's (UCB) research on the properties and behaviors of isolated atoms— potential building blocks for quantum computers – was profiled on September 21, 2023.

An August 23, 2023 article highlights the transformative research achieved by **Gopala Anumanchipalli** and his UCSF colleagues that combined artificial intelligence and novel brain implants to allow paralyzed individuals the ability to speak. This work was also featured in a New York Times article published the same day.

On May 18, 2023, UCSF provided an informative peek inside **Yoshimi Fukuoka**'s research that utilizes a Chatbot to help educate and reduce current disparities related to women's knowledge about heart disease risk.

The work of **Marina Radulaski** (UCD) and **Irfan Siddiqi** (UCB) to transform how future quantum computers and their networks operate, was highlighted in a January 25, 2023 piece originally published by UC Davis College of Engineering.

INITIATIVE EVENTS

Over the last year, the Initiative engaged the Noyce Trust and supported researchers in a number of gatherings and events.

UC Noyce Initiative researchers involved in the WBHI

On May 9, 2023, UC Berkeley hosted the Noyce Trust for a roundtable discussion with three Initiative funded researchers (Gopala Anumanchipalli, Ziad Obermeyer, David Wagner). In addition to learning more about their research and the difference the Initiative funding made in supporting their work, the Noyce Trust also engaged with leaders of the UC Berkeley innovation and entrepreneurship ecosystem.

On May 15, 2023, UC Santa Barbara hosted the Noyce Trust to discuss the planning and agenda for the November 16, 2023 Ann S. Bowers Women's Brain Health Initiative launch event. In addition, the Noyce Trust received an update from the project's lead principal investigator Emily Jacobs.

On October 29, 2023, the Executive Committee met with Noyce Trustees in San Jose to reaffirm their commitment to the Initiative and to outline how to more effectively engage the Noyce Trust moving forward. During the meeting, the Executive Committee agreed that planning yearly campus visits for the Noyce Trust to engage directly with researchers at each campus was a fantastic opportunity for engagement outside of and in addition to the yearly symposium. The Noyce Trust will also attend and participate in the yearly award selection process with the Executive Committee following the peer review process.

150 attendees at the November 16, 2023 WBHI event

On November 16, 2023, the Initiative gathered in San Jose at The Tech Interactive to highlightf the Ann S. Bowers Women's Brain Health Initiative (WBHI). The event brought together over 150 attendees to learn about the Initiative and the research being done by the WBHI. The launch event featured speakers and panel participation from all campus partners as well as an opportunity for all attendees to network and connect with colleagues from other campuses.

"Our campuses have a long legacy of innovations and leaders that have created groundbreaking products, revolutionary companies, and entirely new industries. The opportunity to honor the legacy of Robert Noyce allows us to work in even closer partnership with each other."

-- UC Noyce Initiative Executive Committee

Appendix 1: 2023 UC Noyce Initiative Award Summaries

Miguel Eckstein
Distinguished Professor,
Physiological & Brain Sciences
UC Santa Barbara

Computational Virtual Patient to Predict Perceptual Capabilities of Prosthetic Vision

Close to 300 million people around the world live with irreversible vision loss. Although recent advances in gene and stem cell therapies are showing great promise as a near-future treatment option for end-stage retinal degeneration, and some affected individuals can be treated with surgery or medication, there are currently no effective treatments for many people blinded by severe degeneration or damage to the retina, the optic nerve, or cortex. An electronic visual prosthesis that electrically stimulates surviving cells in the visual pathway to evoke visual percepts (phosphenes) is a viable option. There are currently over twenty academic and industry groups across the world developing prosthetic vision devices implanted at retinal or cortical sites. However, current devices elicit rudimentary phosphenes that look nothing like natural vision. Much of the effort of the industry has been on the challenges of the device development and deployment to the patient with less focus on a scientific approach to understanding and developing tools on how the patients' brains use the phosphenes to see and accomplish everyday tasks. Thus, a fundamental gap in the field is trying to understand what a patient might or might not be perceptually capable of with the resulting bionic vision phosphenes before implanting the prosthetic device. Developing a tool to predict what a prosthesis implant recipient would be able to perceptually accomplish is critical to evaluating different potential devices, optimizing prosthetic designs to maximize the perceptual capabilities of patients, and providing objective quantitative information to a patient about what they might and might not be able to see with the implant. The goal of this proposal is to leverage expertise in computer science, imaging science, and perceptual psychology to develop such a tool, a Computational Virtual Patient. We propose to use a validated model of prosthetic device phosphenes which are directed as inputs into a Deep Neural Network to make predictions about perceptual accuracy in shape and object identification, search localization, and face detection tasks for patients with retinal or cortical implants. We model the multi-phosphene camera samples generated by the patient's head movements to explore the scene. We propose to validate the Computational Virtual Patient by testing normal-sighted individuals experiencing the phosphenes in an immersive environment and performing the perceptual tasks. If successful, the Computational Virtual Patient would allow prosthetic developers to virtually evaluate and optimize potential designs and generate quantitative metrics of the perceptual capabilities in everyday tasks. Furthermore, such predictive perceptual capability tools could become an important instrument for regulatory approval by the Food and Drug Administration (FDA) of new prosthetic devices. The forward-looking research project is interdisciplinary spanning computer science, engineering, imaging science, and perceptual psychology, does not fall into the typical areas of the federal agencies, and has no preliminary results.

Soheil Ghiasi
Professor, Department of Electrical and Computer Engineering
UC Davis

ACE: Accurate, Computationally-Enhanced and Equitable Intrapartum Fetal Monitoring

Despite significant cost and clear evidence of health risks associated with Cesarean section surgeries (C-sections), an unnecessarily large number of infants in the US are delivered via C-sections. The high rate of C-sections in the nation, relative to globally accepted norms, is in part attributed to the high false positive rate for detection of fetal hypoxic distress, associated with the currently-used, half-a-century-old, nonspecific intrapartum fetal monitoring technology. The long-term vision of this project is to address this problem, by developing a non-invasive intrapartum fetal health monitor that can accurately detect fetal hypoxic distress during labor and delivery, via direct and non-invasive measurement of fetal blood oxygenation.

Specifically, we have developed the technology and built a device prototype for non-invasive, transabdominal measurement of fetal arterial blood oxygen saturation (fSpO2). The device works by shining light in the abdominal area at two specific near infrared wavelengths, followed by sensing the faint back scattered light reflections transcutaneously at multiple sites on the maternal abdomen. The sensed dual-wavelength multi-channel signals are subsequently processed using computationally-enabled machine learning algorithms to infer fSpO2. In addition to sensed signals, the algorithms take advantage of contextual auxiliary information, such as patient physical measurements, skin color, maternal heart rate & respiratory rate, maternal oxygen saturation, and fetal heart rate, which are available and/or independently measured. The device prototype is successfully validated in preliminary preclinical tests, including in gold standard pregnant ewe with hypoxic fetal lamb model.

The proposed project will enable our team to take critically-important steps in the journey to advance the concept towards impacting standard of care for childbirth through two specific objectives: 1) demonstration of the technology in expectant mothers during labor and delivery via a pilot patient study; and 2) investigation and mitigation of the impact of patient's and fetal skin color on non-invasive light-based fetal sensing, which has significant equity and disparity ramifications in patient care. The anticipated preliminary intrapartum patient data will enable our team to cross the "valley of death" in funding support that characterizes the gap between foundational technology development (already supported by NSF) and clinical research (planned NIH applications).

Anu Manchikanti Gomez
Associate Professor, Social Welfare
UC Berkeley

Computational Approaches for Understanding and Intervening Upon Misinformation About Contraception and Abortion on Social Media

This comprehensive, mixed methods study will describe the state of sexual and reproductive health (SRH) misinformation among young people (ages 13-25) in the U.S., focusing on Black, Indigenous, and People of Color (BIPOC) youth. Misinformation (factually incorrect information) and disinformation (misinformation that is spread intentionally) are serious and worsening threats to SRH equity: without the resources to understand and apply credible health information, individuals may avoid care and/or seek out non-evidence-based solutions. The spread and impact of misinformation has been exacerbated by social media. TikTok specifically is widely used by youth and has been identified as spreading SRH misinformation in journalistic investigations. BIPOC youth may be particularly vulnerable to SRH misinformation: for these young people, inequities in access to SRH information and healthcare, combined with increased likelihood of exposure to misinformation, create barriers to SRH equity.

Part 1 of the study will characterize the extent and nature of misinformation on contraception and abortion on TikTok. We will utilize a mixed methods human-in-the-loop approach, first conducting qualitative content analysis (QCA) to identify TikToks communicating misinformation and identify the themes they address and then use natural language processing (NLP) to characterize the misinformation. Using contraception and abortion-related search terms, we will scrape relevant TikToks to obtain videos, images, hashtags, comments, and metadata. We will consider two samples for each topic (contraception and abortion): 1) TikToks with the most likes, creating a dataset of TikToks with the greatest reach; 2) a random selection of TikToks from the last year, capturing the range of information being shared. We will examine approximately 4000 TikToks with a team of 15-20 undergraduate researchers. Following QCA, we will employ topic modeling, an NLP approach of unsupervised machine learning that identifies patterns in a corpus of text. NLP will be conducted on four datasets: most viewed and recent posts for both contraception and abortion TIkToks with misinformation.

In Part 2, we will conduct an informational corrections experiment to identify and test how different social framings affect interpretations of SRH misinformation and subsequent corrections, with a focus on differences by race/ethnicity. Our informational corrections task involves random assignment to conditions where we present misinformation items about contraception and abortion informed by Part 1 and then ask participants about their interpretations of the content. Subsequently, information items will be reintroduced with a correction, alongside a specified social framing. We will examine responses to different social framings of the original and corrected information. These results can be used to make targeted improvements to online systems to increase the adhesion of trustworthy SRH information among youth. We will conduct the experiment using a national survey of 1000 13-25-year-olds. Data will be collected by the YouGov Scientific Research Group using their online opt-in panel of U.S.-based respondents representing all demographics.

Notably, the federal government has implemented an interim ban of TikTok on devices used in the performance of federal contract, so applying for funding from the National Institutes of Health or National Science Foundation is not currently an option for this project.

Adeline Nyamathi
Distinguished Professor, Nursing
UC Irvine

Establishing the Foundations of Emotional Intelligence of Care Companion Robots to Mitigate Agitation among High Risk Dementia Patients via Emphatic Patient-Robot Interactions

There are an estimated 6.7 million persons living with dementia; expected to increase to 13.8 million by 2060. Those at highest risk, persons experiencing moderate to severe dementia (P-MSD), are 4-5 times more likely to fall than people without dementia as they often experience unpredictable agitation, leading to unsteady gait. Further, for those injured, the risk of sustaining a fracture is three times higher than for cognitively well people. While successful communication-based strategies to reduce agitation are not widely known, caregiver experiences and recent literature suggest that a caregiver's ability to relate to the P-MSD and show empathy may reduce agitation. While socially assistive robots may have the potential to mitigate agitation through novel forms of verbal and non-verbal interactions, using their onboard vision and audio-sensing technologies and interfaces (e.g., displays), these robots fail to address the dynamically changing emotional states associated with agitation, such as anger, fear, or sadness. As emotions play a significant role for increased agitation, there is insufficient understanding how emotional states change, how they impact agitation and gait over time, and – most importantly – how social robots can best respond to these emotional disturbances by showing empathy in verbal interactions and communication with the patient.

This proposed study is innovative and societal impact is significant by designing and validating a foundational model of emotional intelligence for empathic patient-robot interaction that mitigates agitation among those at highest risk, P-MSD. Our stellar team will use a design science approach to: 1) collect and store granular, personal, chronological data (Personicle), a patient-centric temporal activity/states database, using real-time visual, audio and physiological sensing technologies (both in a simulation lab and in the community; 2) develop statistical models to understand and forecast a P-MSD's emotional state, agitation level and gait in real-time using ML/AI and the Personicle; 3) design an empathy-focused conversation model, focused on storytelling for successful audio and text-based human-robot interaction that considers a person's emotional state, and validates it in a simulation lab; and 4) tests and evaluates the empathy-focused conversation model for the Care Companion Robot (CCR) in the community. Our unique and innovative scientific contributions for Aims 1-3 include: 1) a novel real-time database of Personicles of P-MSD for modeling emotions, agitation, and gait; 2) new temporal and P-MSD-specific AI/ML models for emotions, agitation, and gait; and 3) a new empathy-based conversation model focused on storytelling, including a user interface design for a CCR, specifically designed for P-MSD living in board and care facilities. For Aim 4, our outcomes will be reduction of degree and duration of agitation, reduction of negative emotional states (e.g. anger), falls, and improvement in caregiver burden, as well as assessment of usability & trustworthiness. This high-risk, high-reward research is unlikely to be funded by NIH or other traditional sources as currently no pilot data exists. Our study will be the first of its kind to use a data science approach to build conversational models for P-MSD, using a care patient-companion that we will pilot in the community.

Isabel Rodriguez-Barraquer
Associate Professor, Medicine
UCSF

A Unified Framework to Study the Local Transmission Dynamics of Infectious Disease from Multiple Data Sources

The majority of the burden of respiratory infectious disease originates from local transmission, such as within households, schools, workplaces, and public transportation. These individual patterns can manifest at small spatial scales, such as zip codes, neighborhoods, and counties, leading to highly heterogenous outbreak dynamics. In turn, local outbreak dynamics can provide insight into the human factors driving infectious disease outbreaks. Yet, outbreak dynamics at small spatial scales are often understudied due to a lack of computational approaches to do so.

For infectious disease surveillance, public health collects a multitude of data sources. Namely, through case (PCR-testing), wastewater, seroprevalence, and genomic surveillance. Each of these data types has different strengths and weaknesses. Case data collected through PCR testing of patients who seek care suffers from under-ascertainment, the degree of which can vary over time and across different locations, but allows for the accurate quantification of effective reproduction numbers. Wastewater surveillance is less biased, but viral concentrations can be noisy and are complex to map to prevalence in the population. Seroprevalence allows a relatively accurate estimation of cumulative incidence but is better suited to investigate longer time windows. Genomic data allows us to connect cases across locations and estimate rates of introductions but is often less certain about transmission rate estimates than, for example, estimates from case data.

In this project, we will develop an open-source unified computational framework to quantify local scale transmission dynamics jointly from multiple data sources. We hypothesize that a unified inference approach will allow us to utilize the strengths of each data source while overcoming their limitations, providing more accurate epidemiologic inference. The project is organized into the following aims:

Aim 1: Develop a framework for joint inference of local transmission dynamics from genomics, case, and seroprevalence data. We will devise a Markov chain Monte Carlo approach to infer time-varying prevalences, effective reproduction numbers, and the contribution of local spread and introduction. Aim 2: Validate performance using cross-county transmission dynamics simulations. Using geographically structured SIR simulations, we will simulate cross-county transmission dynamics to evaluate our inference approach and evaluate its sensitivity to biases. Aim 3: Quantify the transmission dynamics of SARS-CoV-2 across the Bay area during the pandemic. Using publicly available genomic, case, wastewater, and seroprevalence data, we will quantify the effective reproduction number of SARS-CoV-2 in the Bay area counties between the beginning of 2020 and the Spring of 2023, as well as the degree to which introductions drove that spread, and whether these patterns changed with non-pharmaceutical interventions. Using these estimates, we will then investigate if the safe graph mobility patterns can fully explain the connectivity of the counties and the changing transmission hotspots during the pandemic.

Our proposal spans the development and implementation of novel computational methods for epidemiological analyses, evaluating the impact of socioeconomic factors on infectious disease transmission, and uses a variety of different data sources. Individual aspects of this project might be fundable through the NIH or NSF, but it is unlikely that individual agencies would fund the entire project.

Jonathon Schofield
Assistant Professor, Mechanical and Aerospace Engineering
UC Davis

Transforming the Accessibility of Bionic Prosthetic Limbs by Leveraging Modern Computational Approaches and the Emerging Standard of Amputation Surgery

The loss of an upper limb (UL) has far-reaching implications, impacting the daily activities, work, and social interactions of those affected. This creates a substantial societal burden due to reduced independence, limited workforce participation, lifelong specialized medical care, and reliance on prosthetic limbs. Amidst the multitude of prosthetic limbs available, they fall short in providing function to offset the physical, emotional, and societal challenges users face. Emerging bionic prostheses are highly functional and intuitive devices operated by accessing signals directly from the nervous system. They can dramatically improve patient outcomes and transition user perceptions from dependence on functionally limited machinery to possessing a truly integrated limb replacement.

Access to bionic prostheses is extremely limited. Current approaches necessitate highly specialized teams and experimental surgeries at select medical centers, often involving implanted hardware that must later be removed (within a few months to years). Our work aims to reduce the barriers to the tremendous potential that bionic prostheses offer in improving patients' functional capabilities. We will leverage two emerging computational and surgical advances in amputee care: 1) A rapidly emerging standard-of-care surgery designed to prevent nerve-related pain (N-TMR), and 2) innovative applications of machine learning (ML) to predict intricate missing hand movements based on data from N-TMR muscle activity.

N-TMR surgery prevents pain by rewiring (reinnervating) severed nerves from the missing hand to muscles remaining in the residual limb. After healing, when patients attempt to move their missing hand, the reinnervated muscles contract. Our hypothesis is that measuring this muscle activity and applying modern ML techniques will accurately predict dexterous missing hand movements, a crucial step towards effective bionic prosthetic control.

Specific Aim 1 will capture N-TMR muscle activity data using electromyography and ultrasound imaging. Participants will attempt various missing hand grasp movements, and we will evaluate the accuracy of ML algorithms in predicting grasps from each measurement modality and their fusion.

Specific Aim 2 will assess N-TMR patients' ability to modulate muscle activity. By measuring simultaneous intact-hand and missing-hand movements, we will investigate how N-TMR muscle activation encodes grasp forces and positions. This insight is pivotal for achieving fine-grade proportional position and force control, essential for effective prosthetic use.

This work has been challenged to attract extramural funding. Positive reviews from the NIH MRS Study Section, DoD Congressionally Directed Medical Research Program (twice), and the American Foundation for Surgery of the Hand have highlighted our strong experimental approach while raising concerns about the risks associated with the technical aspects. Health-focused programs suggest the work is too technical for their scopes and require further maturity for translation, while technology-focused programs suggest the work is too applied to contribute to the science underpinning ML or muscle sensing technologies. Noyce funding will allow further mature of our techniques and build the necessary evidence to strengthen feasibility and successfully attract clinically or technically focused funding. Our goal is to leverage this project to establish the requisite footing and gain support for multi-institutional observational studies that help translate our techniques into an accessible bionic prosthetic solution.



Sanjit Seshia
Professor, Electrical Engineering and Computer Sciences
UC Berkeley

Yasser Shoukry
Associate Professor, Electrical Engineering and Computer Science
UC Irvine

Cathra Halabi
Assistant Professor, Neurology
UCSF

Personalized, Privacy-Preserving, Mixed-Reality Platform for Home-Based Patient Rehabilitation

Patients recovering from conditions such as stroke may face prolonged wait times before evaluation by a recovery specialist. These delays can be exacerbated by limited mobility or transportation, hindering regular clinic visits and adherence to prescribed rehabilitation regimens. In this proposal, we will create a personalized home-based rehabilitation platform leveraging the latest advancements in Mixed Reality (MR) technology. By seamlessly integrating digital elements into the physical realm, MR offers a promising approach to home-based rehabilitation. This approach enhances the comprehension of individual movement patterns remotely, enabling clinicians to tailor assessments and interventions with an unparalleled level of precision. Nonetheless, the integration of MR-based rehabilitation into standard healthcare practices encounters a complex web of challenges. These challenges encompass (1) the absence of automated yet personalized assessments and rehabilitation routines, crucial for aiding underserved patients who lack convenient access to in-person clinical attention; (2) apprehensions concerning the privacy and security of sensitive data gathered by MR devices, and (3) inadequate engagement of critical stakeholders, including patients themselves, recovery and rehabilitation specialists (e.g., physicians and therapists), and health insurance providers, in the design of these homecare platforms.

In this project, our primary objective is to tackle these intertwined challenges to develop a personalized, privacy-preserving, mixed-reality platform for home-based patient rehabilitation. This platform, called ScenicMR, incorporates innovative algorithms to generate training exercises and physical assessments operating within a designed MR environment, ensuring they adhere to clinical guidelines while maintaining safety. Our project leverages Scenic, a probabilistic programming system developed by the PI's group at UC Berkeley for modeling a stochastic world in which autonomous agents and humans interact, including MR environments. Drawing insights from assessment outcomes and training performance, our algorithm creates a personalized sequence of Scenic programs encoding exercises for each subject, progressively tailoring the curriculum to escalate in complexity. Additionally, the algorithm will adapt the exercise count per program to personalize the training pace. We will also develop a privacy safeguard that oversees video feeds and sensor data from MR devices. This safeguard will modify content in a manner that protects the privacy of patients and their surroundings. Simultaneously, it will permit remote healthcare providers to conduct medical evaluations or interpret progress. Through clinical studies conducted via UCSF, our project will assess the feasibility of deploying these developed technologies via clinical settings and explore outcome measures before and after ScenicMR treatment.

This project is multidisciplinary and brings together expertise from neurology, artificial intelligence, formal methods and automated reasoning, cyber-physical systems, security and privacy, and human-computer interaction. Unfortunately, projects that combine engineering/computer science research and clinical studies in medicine fall into the cracks between the traditional borders of what is funded by the National Science Foundation (NSF) and the National Institutes of Health (NIH), which makes UC Noyce the perfect venue to pursue such high risk-high reward research.

Geoffrey Tison
Associate Professor, Medicine
UCSF

Development of Novel Multi-Modal Physiologically-Focused Artificial Intelligence Algorithms

Machine learning (ML), or artificial intelligence (AI), has made large strides in medicine, but additional innovation is needed to tailor AI algorithms for medical applications. In particular, deep neural networks (DNN) offer the computational and conceptual possibility to analyze multiple data modalities simultaneously, similar to how human physicians make diagnoses, which is particularly critical in medicine. Our previously published work demonstrates that DNNs can extract maximal information from raw medical data, and our proof-of-concept preliminary data demonstrate that multimodal DNNs can be developed to improve disease prediction and prognostication. This project proposes to radically redesign how medical AI algorithms are developed by establishing a novel multi-modal, physiologically-focused DNN architecture optimized for medical tasks, then to apply this general-purpose algorithm to achieve prediction and phenotyping of heart failure (HF), one of the greatest unmet needs in cardiovascular medicine. This will potentially allow earlier and more accurate diagnosis of HF and identification of relevant subtypes for dedicated therapy. The resulting multi-modal architecture will be a general-purpose medical AI platform that can later be trained for countless other disease tasks using any relevant data modalities. The second Aim of this project will validate and further refine this HF multi-modal DNN algorithm by leveraging an existing highly-valuable cross- University of California (UC) multi-modal cohort database that combines data from all 5 UC health systems. The large-scale UC system data offers an unparalleled opportunity to train powerful AI algorithms as we propose, since such large-scale training data is critical for optimal AI performance. If successful, we will produce a novel medical algorithm platform, similar to a new biomarker platform or assay, providing a general approach useful to build precision-medicine algorithms for countless diseases and medical tasks. Herein, we propose to fundamentally redesign how medical AI algorithms are trained, offering the promise of developing multi-modal AI techniques that mirror the complex medical decision-making of physicians. Such a high-risk sweeping re-design of medical AI is not suitable for traditional funding mechanisms, making the Noyce mechanism ideal to provide the strong basis for additional follow-on funding applications to traditional mechanisms.

Shafi Goldwasser
Director of the Simons Institute for the Theory of Computing
UC Berkeley

Simons Institute Research Program on Cryptography: Obfuscation, Secure Systems, and Secure Computation

In an era where we have witnessed how data utilization can enable previously unthinkable progress across all domains of science (life, exact and social), healthcare, finance, and social connectivity, maintaining the privacy of sensitive personal data while leveraging it is at a critical juncture. At the same time, in the context of an upcoming international AI arms race, it has become clear that powerful machine learning algorithms will have to adhere to verification and auditing methods that ensure their correctness and trustworthiness even when executed in remote and adversarial environments.

Cryptographic tools have been crucial to both the goals of privacy and verification in the presence of adversaries. They enable safeguarding information in transit and in situ as well as when used in collaborative computation, amongst multiple distrustful parties who wish to extract utility from the union of their information, without sharing it fully. They also enable efficient protocols that verify the correctness of remote program executions and use of data, without replication or full knowledge of the internal details of the remote programs being verified.

To address these issues, the Simons Institute for the Theory for Computing proposes to organize a research program in Summer 2025 on Cryptography, focusing on obfuscation, secure systems, and secure computation. Featuring a cohort of 60-70 senior and junior researchers from academia and industry, the proposed program will extend existing theoretical cryptographic protocols and models to the context of machine learning, larger-scale multi-party collaborations on private data when adversarial parties are present, and new untrusted execution environments.

Traditional research funding from federal agencies focuses on research projects in which a small number of faculty collaborate over a longer period of time, and not on the kind of focused, time-bounded research program we are proposing. The Simons Institute's model, by contrast, features a semester- or summer-long transformative research program that supercharges research in a specific area by convening the world's leading experts and rising stars in the topic, and typically results in well over 100 research papers within a year. The impact of such a program stands in stark contrast to the dearth of federal funding for initiatives of this sort. Funding from the Noyce Initiative would make an invaluable contribution to this project, unlikely to be matched by traditional sources.

Javad Lavaei
Associate Professor, Industrial Engineering and Operations Research
UC Berkeley

Cyberattack Detection for the US Power Grid Using Machine Learning and AI Techniques

To improve the efficiency, resiliency and sustainability of power systems and address climate issues, the operation of power systems is becoming data centric. Data analytics plays a critical role in the economic and reliable operation of the grid because major operational problems, such as security-constrained optimal power flow, contingency analysis, and transient stability analysis, rely on the knowledge extracted from sensory data. The current industry practice is based on a set of heuristic iterative algorithms proposed in the 70s, which are known empirically to work properly under normal situations but become brittle under adverse conditions, such as natural hazards, equipment faults, and cyberattacks. In this project, we aim to study dynamic data to address the following objectives: (1) how to design a set of machine learning (ML) and artificial intelligence (AI) algorithms with mathematical guarantees to detect cyberattacks and anomalies? (2) how is the performance of each algorithm related to the number and locations of sensors and types of measurements? (3) what is the trade-off between the accuracy of each learning algorithm and the computational power needed by the algorithm? (4) in case the precise attacked region cannot be pinpointed, what is the smallest region containing the attacked region that each algorithm can identify? (5) how to fortify the grid to ensure that it is incapable of propagating misinformation in case of a cyberattack on data? (6) how is the severity of the effect of a cyberattack related to the amount of knowledge about the grid that is available to the attacker? (7) study two scenarios of coordinated attacks and uncorrelated faults, (8) study cyberattacks for an integrated distribution-transmission model.

Amir Rahmani
Professor, Nursing and Computer Science
UC Irvine

Safeguarding Privacy of Cardiovascular Waveforms through Reinforcement Learning-Guided Generative Models

AI-driven smart healthcare services heavily rely on time series bio-signals (e.g., ECG) in facilitating big data analytics. However, privacy concerns restrict public sharing of patients' cardiovascular bio-signals, impeding the advancement of AI models for predictive and preventive healthcare services. Privacy concerns are further heightened by recent advancements in remote bio-signal sensing, exemplified by technologies like radar-based ECG monitoring. Conventional data de-identification techniques are primarily targeted at structured data, ignoring the criticality and inherent biometric nature of bio-signals. Alternatively, bio-signal anonymization through synthetic data generation has been widely used for privacy preservation, modeling data distribution at a population level. However, existing synthetic data generation techniques ignore the possibilities of bio-signal re-identification at an individual sample level, lack diversity with exclusive reliance on fixed training datasets, and undermine the utility of anonymized bio-signals. Recent research has shown that attackers can employ machine learning techniques to infer the identity of cardiovascular bio-signals. This underscores the importance of superior anonymization strategies and a deep understanding of potential data linkages to safeguard privacy.

In this proposal, we present utility-aware anonymization of multi-channel cardiovascular bio-signals through deep generative AI models. Our objectives are twofold: (i) at an individual level, we safeguard patients from identity disclosure and attribute inference attacks, and (ii) at the population level, we enable the creation of public datasets to advance predictive modeling for smart healthcare services. Our approach balances the conflicting objectives of obfuscating potentially re-identifiable details to ensure anonymity while simultaneously retaining essential information for data utility. To achieve this, we design a reinforcement learning agent to understand complex structural dynamics within timeseries cardiovascular bio-signals. The agent guides the generative models for anonymizing multi-channel bio-signals, preserving the morphological structure of bio-signals for utility and obfuscating re-identifiable details for anonymity. Further, the agent intelligently controls the latent space, enabling low-overhead methodology for updating the bio-signal anonymization models to fit diverse sets of patients and cardiovascular conditions, and fine-tuning utility-anonymity trade-offs. We design an evaluation framework that integrates key utility and anonymity metrics for assessing the efficacy of the anonymization models. The evaluation framework provides feedback for updating the anonymization models through the latent space control as guided by the reinforcement learning agent. Anonymization techniques from this research can mitigate bio-signal re-identification attacks, ensuring the privacy of clients and fostering collaboration between data holders and the machine-learning community.

While the potential impacts of this research are profound, the design space is extremely large, encompassing numerous variables such as distinct categories of bio-signals, spatiotemporal coherence among channels within a bio-signal (e.g., 12-lead ECG), assorted cardiovascular conditions, and heterogeneous population demographics. These complexities render it impractical to secure funding through federal bodies like NSF and NIH in the current phase. Through the UC Noyce Initiative, we aim to demonstrate the feasibility of our approach using ECG as a representative model of a broader spectrum of bio-signals. This choice is warranted by ECG's prevalence as the predominant source of time series data within the digital healthcare domain, thereby positioning us for future endeavors to secure substantial federal grants.

David Wagner
Professor, Electrical Engineering and Computer Sciences
UC Berkeley

Hao Chen
Professor, Computer Science
UC Davis

Christopher Kruegel
Professor, Computer Science
UC Santa Barbara

AI for Cybersecurity

We will develop methods to improve cybersecurity through appropriate use of AI and machine learning. As society becomes more digitally connected, cyberthreats become increasingly important, and we are facing evolving threats that are challenging to keep up with. Recent advances in machine learning and AI provide opportunities to support defenders in protecting computer systems against attacks. Building on advances in large language models (LLMs), we will build methods and tools to help security teams in multiple areas, including analysis of alerts and logs and other operational data; detection of intrusions from network data; and analysis of software source code to proactively identify security vulnerabilities before they are exploited. Many of these applications involve making sense of large amounts of textual data. We hypothesize that large language models and other AI/ML techniques can be useful for making sense of the data and supporting analysts, software developers, and security teams. Some technical challenges involve applying these methods to new domains, identifying appropriate data representations in each domain, handling structured or semi-structured data, and hardening models against adversarial attempts to manipulate them or evade detection. Our team is well-qualified to address these challenges, with extensive expertise in application security, network security, and software security, as well as expertise in AI and ML. The potential societal impact is a reduction in security breaches and compromises, more trustworthy computer systems, and enabling smaller companies and organizations to have more effective security practices at a lower cost. The field is moving fast, with major advances in large language models in the past 8 months, and with the release of open source models (LLaMA, LLaMA 2) in 2023, we see an opportunity to have an impact now. This research is hard to fund through traditional/federal sources because of the lengthy delays they involve.

UC Noyce Initiative
2023 Call for Applications

OVERVIEW

The UC Noyce Initiative is a partnership between five University of California campuses (Berkeley, Davis, Irvine, San Francisco, Santa Barbara) that honors the legacy of Ann S. Bowers and Robert N. Noyce by advancing computing, information science, and engineering for the benefit of society. To further this aim, the UC Noyce Initiative intends to support research efforts that are innovative, have the potential for high-impact, and hold a strong promise for follow-on funding. The UC Noyce Initiative is particularly interested in supporting high-risk, high-reward research that typically does not qualify for traditional or federal funding agencies. In 2023 the UC Noyce Initiative requests proposals in two thematic focus areas: (1) **Computational Health**; (2) **Privacy and Security**.

Computational Health: Computing and new sources of data have transformed how we address medical and public health questions that were once insurmountably complex. We have the potential through data analytics, machine learning, and new digital devices to revolutionize disease treatments, reduce the impact of infectious disease, fight health disparities, and much more.

Privacy and Security: In our increasingly digitally networked world, data and algorithms used for decision making are creating new opportunities and challenges. In this context, individuals, organizations, and government agencies worldwide need to ensure that their systems are safe from cyberattacks, that algorithms are used ethically, and that private data is not misused. Cybersecurity, privacy and responsible use of AI/ML will be critical to ensuring safety as the world is transformed through advanced digital technologies.

AWARD DETAILS

Researchers may apply for either a Multi-Campus Partnership Award or a Single Campus Award. The Initiative anticipates awarding up to four Multi-Campus Partnership Awards and up to 10 Single Campus Awards in 2023.

Award Type	Budget Maximum (total costs)	Award Duration	Partnership Requirements
Multi-Campus Partnership	Up to $1 Million	2 years	Inclusion of a least 3 initiative campuses
Single Campus	Up to $300,000	2 years	NA

Appendix 2: 2023 Request for Proposals

ELIGIBILITY

- Principal Investigator (PI) status at one of the UC Noyce Initiative campuses.
- A researcher may only serve as PI on one application and may only participate in up to three awarded projects.
- Current and previous UC Noyce Initiative award recipients are eligible to apply.

APPLICATION GUIDELINES

Applications will include the following components and utilize this application template:

Proposal Title: Please insert a concise but descriptive title of your proposal.

Select your Thematic Area (dropdown): Computational Health or Privacy & Security

Select Award Type (dropdown): Single Campus or Multi-Campus Partnership

Have you previously received a UC Noyce Initiative award (checkbox): (Yes/No). Please note this will be used for UC Noyce Initiative tracking purposes only.

PI Name, Campus, Contact: Please enter your name, job title, your affiliated campus, and contact email. (Partnership awards will be required to provide these details for each partner campus PI)

Keywords: Please provide three keywords that best describe the research to be conducted.

Abstract (500 word max): Please outline why the research is needed/important and the potential broader impact it would have on society; an overview of the scientific approach(es) to be used; and a statement on why the proposed research is not fundable by other traditional/federal funding sources.

Impact Statement (200 words max): Explain how the proposed research may impact your field, technology, and society.

Research Narrative (5 pages max):

The research narrative should include the following information:

- Background/rationale
- Specific aims, research methodology, and milestones
- Innovation – highlight the innovation involved in the approach, technology, solution etc.

- Impact – explain the potential impacts of this research on your field and society and, if applicable, the translational potential of the proposed research.
- ***Multi-campus partnership applications only**: Please add up to **1 additional page** to explain how the proposed collaboration will advance your research and impact. Please comment also on how the collaboration will work across the campus partners.

Please ensure that the research narrative is no longer than 5 pages not including references using no smaller than 11-pt font, single-spaced with half-inch margins.

Budget & Budget Justification (not part of Narrative 5-page limit): Please complete the following budget template to outline how the requested funding will be utilized, as well as a 1-page budget justification explaining the proposed costs in each category. Awards may be used to cover relevant research expenses, including salary support, graduate student/postdoctoral research support, supplies & materials, computing expenses, equipment, publication expenses, and travel costs. Indirect costs should not be included.

CVs: Please provide a CV (5 page maximum) for each PI and co-investigators participating on the project. NIH or NSF biosketch formats may be used. Be sure to call out any special qualifications that uniquely qualify you for this project.

REVIEW CRITERIA

Applications will undergo peer review by faculty in fields relevant to the two thematic areas from Initiative campuses. The peer reviewers will assess applications on the following review criteria, which applicants are encouraged to consider when developing their proposals.

The outcome from the review committee will be provided to the UC Noyce Initiative leadership who will finalize the award decisions, based on reviews, program priorities, campus strategies, and available funding.

Multi-Campus Partnership Awards:

Scientific Merit (50% scoring weight)

Are the proposed approaches and methodologies clearly outlined, scientifically rigorous, and appropriate for the proposed research? Is the problem being addressed important and timely? Is the proposed approach innovative? Are appropriate data protection/management systems in place? If the research involves human subjects, are necessary protections outlined and appropriate?

Impact (25% scoring weight)
How impactful would the proposed research be in advancing knowledge, methodologies and/or technology in the indicated thematic area? What is the translational potential of the proposed research? What is the impact on society? How likely is the proposed research to impact follow-on funding?

Strength of the Collaboration (15% scoring weight):
Does the collaboration across the partner campuses strengthen the proposed research? Is the partnership complementary and/or synergistic? Does the proposal outline a meaningful engagement plan across the participating campus partners?

Expertise and Capacity (10% scoring weight)
Do the PIs have the experience and expertise to conduct the proposed research? Does the proposal have the appropriate levels of support and/or complementary expertise to complete the proposed research? Does the proposal outline that the collaboration has the needed equipment, space, or mechanisms in place to successfully achieve the stated goals? Is the requested budget and justification reasonable and appropriate for the successful completion of the research?

Single Campus Awards:
Scientific Merit (50% scoring weight)
Are the proposed approaches and methodologies clearly outlined, scientifically rigorous, and appropriate for the proposed research? Is the problem being addressed important and timely? Is the proposed approach innovative? Are appropriate data protection/management systems in place? If the research involves human subjects, are all necessary protections outlined and appropriate?

Impact (30% scoring weight)
How impactful would the proposed research be in advancing knowledge, methodologies, technologies and society in the indicated thematic area? How likely is the proposed research to be sustainable or obtain follow-on funding after the completion of the outlined research?

Expertise and Capacity (20% scoring weight)
Does the PI have the experience and expertise to conduct the proposed research? Does the proposal have the appropriate levels of support and/or complementary expertise to complete the proposed research? Does the proposal outline that the applicant has the needed equipment, space, or mechanisms in place to successfully achieve the stated goals? Is the requested budget and justification reasonable and appropriate for the successful completion of the research?

Appendix 2: 2023 Request for Proposals

INFORMATIONAL WEBINAR

The UC Noyce Initiative will hold a 1-hour informational webinar where we will provide an overview of the award requirements and an opportunity for applicants to ask questions. The webinar will be held June 27, 2023 at 12:00pm (noon) via Zoom at the following link: https://berkeley.zoom.us/j/95508508861 (Meeting ID: 955 0850 8861).

HOW TO APPLY

To submit your application, please use the UC Davis InfoReady Platform (linked here). Please be sure to complete all requested information, use the application template provided, and upload a PDF of the application materials where indicated. Application materials will be uploaded as three separate files: 1.) A single PDF that includes the research narrative and budget justification; 2.) a PDF of the completed budget template; and 3.) A single PDF of all investigator CVs. Applications must be submitted via InfoReady by **August 15, 2023 at 6:00PM.**

ANNUAL REPORTING AND SYMPOSIUM

All award recipients will provide an annual progress report. Awardees will also be invited and encouraged to participate in the annual UC Noyce Initiative Symposium.

QUESTIONS AND CONTACT INFORMATION

Should you have any questions about the application requirements or process, please contact Gretchen Kiser (UCSF) at rdoinfo@ucsf.edu

For questions about accessing and submitting your application in InfoReady, please contact Ana Lucia Cordova (UC Davis) at strategicinitiatives@ucdavis.edu

Please also reference the **Frequently Asked Questions** document linked here. This document will be updated regularly until the application due date.

2023 TIMELINE

Call for Applications Released: June 14, 2023
Informational Webinar: June 27, 2023 at 12:00PM
Applications Due: August 15, 2023 by 6:00PM
Award Start Date: October 1, 2023