CITRIS STRATEGIC PLAN

CITRIS

CENTER FOR INFORMATION TECHNOLOGY RESEARCH IN THE INTEREST OF SOCIETY

1 THE CITRIS MISSION

Established in 2001, the Center for Information Technology Research in the Interest of Society (CITRIS) is charged with producing novel IT solutions that address far-reaching societal challenges.

CITRIS accomplishes this by fostering cross-disciplinary, cross-institutional research; bringing together faculty and researchers; and developing the "pipeline" to translate research from the university context to its application in real-world environments. CITRIS leverages the research strengths of University of California campuses at Berkeley, Davis, Merced and Santa Cruz, and operates within the greater ecosystem of the University of California and the innovative and entrepreneurial spirit of Silicon Valley.

2 EMERGING TRENDS & OPPORTUNITIES

The technology landscape changes quickly. We believe that the next 20 years will be dominated by growing connectivity through mobile devices and sensor networks, ever-increasing volume and velocity of data streams, and advances in enabling hardware and materials such as nanotechnologies.

At the same time, some of the most critical societal challenges will be posed by climate change, increasing urbanization, and an aging population in developed countries. The CITRIS context is defined at the nexus of technologically-driven trends and technology-based solutions to key societal challenges.

The main foci for CITRIS are found in the creation of new markets, enabling mass customization while tending to privacy and security needs, and leveraging information technology to improve the resilience of both human-made and natural systems. By "new markets" we point to novel infrastructural or platform technology that catalyzes new business models, such as the vibrant apps marketplace on mobile devices or the profusion of applications built on top of social media platforms. By "mass customization" we refer to opportunities such as personalized health care and rapid, low-cost fabrication of customized products or applications.

In developing new technologies, we are mindful of innovation not for its own sake, but with an eye toward the impact on society—at individual and macro scales.
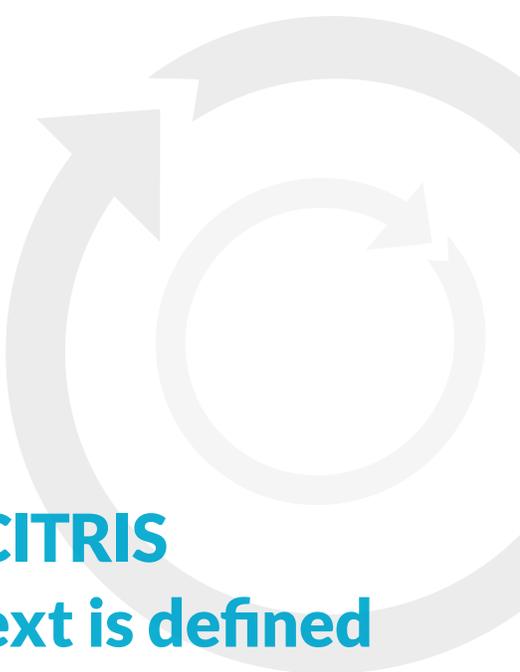
The CITRIS context is defined at the nexus of technologically-driven trends and technology-based solutions to key societal challenges.

3 GOALS
2015-2020

#1 Leverage the multiplier effects of CITRIS as a four-campus institute.

#2 Evolve the research initiatives to respond to emerging opportunities.

#3 Maintain CITRIS's leadership role in the University of California's entrepreneurial landscape.

#4 Strengthen CITRIS as an intellectual community.

#5 Develop a vibrant ecosystem of CITRIS partners.

12-MONTH OBJECTIVES

Continue strengthening connections among the four campuses to share resources and demonstrate the multiplier effect of UCOP's investment.

1. Continue investment in the CITRIS Seed Grant Program to encourage cross-campus collaborations.

2. Convene retreats and workshops for CITRIS faculty, researchers and students to meet each other and learn about research of mutual interest.

3. Build on successful programs such as the CITRIS Mobile App Challenge, the CITRIS Foundry, or the CITRIS Invention Lab that can be replicated across the four campuses.

Revise the CITRIS Initiatives to reflect current and emerging needs in information technology research. Engage faculty leadership to galvanize campus expertise to meet those needs.

1. Create new research thrusts in Sustainable Infrastructures, Health, Connected Communities, and People and Robots. Identify faculty leadership representing the four CITRIS campuses and the staffing structure necessary to support the research programs.

2. Highlight the new initiatives in public events, such as themed series within the CITRIS Research Exchange or recognition at a CITRIS Showcase event.

3. Expand CITRIS's capacity to support collaborative proposals and post-award administration.

Broaden access to CITRIS-supported innovation and entrepreneurship resources, including expansion of the CITRIS Foundry program.

1. Map the entrepreneurial ecosystem on the four campuses to better understand CITRIS's optimal role and contributions. Establish CITRIS Foundry office space in Silicon Valley and strengthen connections to entrepreneurship programs at UC Santa Cruz through joint programming or local team recruitment.

2. Work with the Berkeley Marvell NanoLab on outreach, education, and recruitment of new members within the

Bay Area venture capital investment community and its portfolios of startup companies.

3. Explore collaboration possibilities with partners, including the other Governor Gray Davis Institutes for Science and Innovation.

4. Serve as a model and resource for UCOP leadership as entrepreneurial programs and related policies are being developed system-wide.

Foster a sense of intellectual community via regular exchange among the four campuses and broader technology community.

1. Continue a robust program of public events through the CITRIS Research Exchange series, workshops, and conferences on timely issues.

2. Encourage cross-campus collaboration through the CITRIS Seed Grant Program. Report on previous successes

in this program when seed funding has led to significant extramural investments or other technological advances.

3. Highlight publications, breakthrough research, and novel applications via external communications and media

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Build on the success of current collaborations to expand the CITRIS membership model; create avenues to inform organizations about our research strengths; and enrich the engagement among faculty, students, and partners for mutual benefit.

1. Revise the CITRIS Membership Program tiers and benefits to include opportunities for sponsorship, student recruitment, visiting fellowships, and testbed access.

2. Identify research themes, programs, and assets across the four campuses that are of interest to aligned organizations.

3. Increase the quality of interaction with outside organizations, including an inaugural showcase event for current and prospective members to connect with the CITRIS community.

4. Recruit five or more organizations to support individual initiatives or CITRIS overall.

4 DETAIL ON THE NEW RESEARCH INITIATIVES

Building on existing research strengths and calling out areas of emerging expertise in information technology, we will organize the research initiatives into four focus areas: Sustainable Infrastructures, Connected Communities, People and Robots, and Health. We recognize several themes that cut across all four, including necessary attention to resilience, opportunities presented by big data analytics, and advances in nanotechnology. We will continue to encourage and drive projects with a sharp focus on solving specific, large-scale problems that leverage the unique cross-disciplinary and cross-campus strengths of CITRIS.

I. CITRIS Sustainable Infrastructures Initiative

II. CITRIS Connected Communities Initiative

III. CITRIS People and Robots Initiative

IV. CITRIS Health Initiative

CITRIS Sustainable Infrastructures Initiative

The CITRIS Sustainable Infrastructures Initiative pursues information technology research in energy, water, and transportation as well as cyber-infrastructure as essential components of a sustainable society. Highways, electrical wires, and water channels are just a few examples of the various often-overlooked systems that underpin societal infrastructure in providing basic human needs. Information technology can weave these interrelated systems—transportation, energy, and water—into a sustainable fabric for the next generation, enabling resiliency and addressing climate change.

Projects in the initiative will build on the momentum of current developments in cyber-physical systems and the "Internet of Things." An important part of our agenda is support for UC President Janet Napolitano's goal of carbon neutrality for the UC system by 2025. Another element of the research agenda is critical infrastructure which must be built to withstand acute events such as natural disasters (earthquakes, wildfires) or human-instigated disruptions (whether by intentional attacks, error, or negligence). Research will also address long-term consequences of climate change such as increasing temperatures and sea-level rise, not only in the United States but also in the Global South, which is expected to hold 60% of the world's population within the next 50 years— much of it concentrated in urban areas.

CITRIS researchers have contributed foundational research in energy-efficient building and grid management and technology; energy harvesting, storage and distribution; and open-source platforms for control as well as collecting, analyzing and visualizing energy data. IT research in water includes the deployment of wireless sensor networks in the Sierras and American River Basin for monitoring the snowpack, water availability and flow. Other key CITRIS faculty apply models and analytics on transportation systems and technology related to urban growth and mobility.

Recognizing the increasing interrelationships among these critical systems, the new CITRIS Sustainable Infrastructures Initiative combines and builds upon the strengths of the previous CITRIS i4Energy Initiative and CITRIS Intelligent Infrastructure Initiative.

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CITRIS Connected Communities Initiative

The Connected Communities Initiative at CITRIS focuses on the affordances of information technology to enhance communities – of learning, of practice, and of governance. The new initiative embraces the development of experimental online platforms and novel hardware and software systems that connect peers to each other and to institutions in meaningful and productive ways. Building on leadership expertise in human-computer interaction, user interface design, as well as political, social and economic development, the initiative will support projects in domains including education (in MOOCs, peer-to-peer expertise sharing and "maker" communities), collaborative design, philanthropy, journalism, public health, citizen science, and ICT policy. It will contribute to our understanding of crowdsourced learning, decision-making and funding. The CITRIS Connected Communities Initiative will support ongoing activities in the CITRIS Invention Lab, Social Apps Lab, Mobile App Challenge, as well as events related to open data, privacy and security, governance, and related topics.

The Connected Communities Initiative emerges from a long history of projects to improve communications among community members and the elected officials, policymakers and institutions making decisions on their behalf. The Data and Democracy Initiative, founded in 2011 and a precursor to the present Initiative, showcased and supported such projects regarding political, social and economic issues. Examples include the California Report Card, Vote Your Mind, Stories of Solidarity, Peer-to-PCAST, and others.

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CITRIS People and Robots Initiative

Cloud Robotics, Deep Learning, Human-Centric Automation, and Bio-Inspired Robotics are primary research themes in the new CITRIS People and Robots Initiative. Robotics and automation are advancing rapidly due to innovations in sensors, devices, UAVs, networks, optimization, and machine learning, accelerated by corporate and private investment. These systems have enormous potential to reduce drudgery and improve human experience in healthcare, manufacturing, transportation, safety, and a broad range of other applications in the interests of society. Achieving this will require sensitivity to human issues, rigorous theory evaluated on standard benchmarks, and modular systems built on shared software toolkits.

People and robots are not mutually exclusive. Predictions of the "Singularity" are a distraction from a more important concept that might be characterized as "Multiplicity," an emerging category of systems where diverse groups of humans work together with diverse groups of machines to solve difficult problems. Multiplicity combines emerging results in collective intelligence and cloud computing, building on research in ensemble learning, big data, and open-source software. Research in psychology, law, ethics, art, and the humanities are essential to provide historical and cultural context and develop appropriate methods for system and policy design that address human issues such as inclusion, privacy, and alienation. Robotics can also enhance education, inspiring interest in STEM topics for students of all ages.

Multidisciplinary research is needed to investigate the basic and applied science for design of systems and robust performance, addressing the inherent uncertainty in sensing, modeling, and actuation used for control, learning, and systems identification. Cloud Computing can provide access to large datasets and clusters of remote processors to filter, model, optimize, and share data across systems to improve performance over time.

The new multidisciplinary, multi-campus CITRIS research initiative will address many of these challenges. The initiative will catalyze new research by faculty and students from the four CITRIS campuses, building on 40 years of research that has produced significant results, a network of alumni, and many active labs and projects. The initiative will also catalyze new research with software, datasets, seminars and collaborations with industry, labs, and public outreach.

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CITRIS Health Initiative

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The CITRIS Health Initiative is built upon a robust history of addressing critical health and health care challenges facing society. The initiative will focus on developing transformative, scalable and sustainable information technology solutions to improve health and wellness. These technology-enabled solutions will improve the quality of care and health outcomes, while reducing health care costs. Current areas of focus address the primary drivers affecting health, including chronic disease, aging, and formal or informal caregiving. Initiative projects build upon the principal technology solutions of telehealth; sensors; mobile apps and gaming; and data analytics. Examples of CITRIS Health Initiative projects include innovations in electronic health records and analytics, the Transatlantic Telehealth Research Network, use of in-home sensors and feedback to reduce asthma in children, virtual reality environments for physical rehabilitation, and interactive mapping to assist wayfinding for older adults.

The global health arena is experiencing rapid advances in informatics, precision medicine, quantified self, mobile health, telehealth, remote monitoring and sensors, health behavior, patient engagement, and health policy and regulation. As a global leader in developing technology-enabled health solutions, the CITRIS Health Initiative will advance innovations in data analytics (as supported by a new health data analytics seed grant program announced in November 2014), hospital-to-home, population health, care management and care transitions, robotics, and mHealth.

CITRIS Health Initiative investigators will continue to develop partnerships with U.S.-based and global health researchers, clinical providers, engineers, and technologists for collaboration in the development of hardware and software solutions, while expanding utilization of the extensive CITRIS innovation ecosystem (including testbeds at the Center for Health and Technology and UC Davis Health System) and other CITRIS facilities and programs.

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5 INVENTION ECOSYSTEM

In addition to the four main research initiatives, CITRIS fosters a strong entrepreneurial community through facilities and programs in our "invention ecosystem."

These programs create a pipeline for students to develop ideas, technologies and business plans, providing a path to guide them from dorm room to boardroom. Among the programs are the CITRIS Foundry (a startup incubator), the CITRIS Social Apps Lab, the CITRIS Mobile App Challenge, and hackathons—many of which leverage the facilities and expertise within the CITRIS Invention Lab. CITRIS also collaborates with more than 20 student-led organizations across all four campuses, and provides connections to campus programs such as Skydeck, CalHacks and the Center for Entrepreneurship and Technology at UC Berkeley; the Senior Engineering Design Program at UC Santa Cruz; the Engineering Student Startup Center at UC Davis; and the Mobile App Challenge at UC Berkeley, Davis and Merced.

The early-stage entrepreneurs in the Foundry and other parts of CITRIS benefit from added visibility and mentorship from corporate partners. Startups from the Foundry have raised capital from a variety of sources including venture capital, angel investment, and federal grants as well as crowdfunding. However, these early stage companies still face funding gaps as they tackle some of the hardest and capital-intensive domain areas such as health and energy. Through the Foundry Partner Challenge program, we engage with external partners who provide industry-specific mentorship and offer additional funding to select Foundry startups. Partnerships have been launched with Samsung, the Berkeley Energy and Climate Initiative (BECI) and the California Institute for Quantitative Biosciences (QB3). We continue to explore opportunities with additional corporate partners.

For advanced research in nanotechnology and semiconductors, the Marvell Nanofabrication Laboratory, housed in Sutardja Dai Hall at CITRIS headquarters, has been home to numerous pathbreaking technological innovations. It acts as a regional center for research, drawing use from fledgling entrepreneurs who need the lab to breathe life into their new ideas, as well as industry leaders such as Intel and HP, which use the lab to explore new materials for advanced microelectronic devices.

6 FINANCIAL STABILITY

Like most public institutions, CITRIS faces ongoing budgetary challenges to ensure that resources meet its operating needs and plans for growth. Currently supported largely by an annual allocation from the University of California Office of the President, as well as supplemental funds from the UC Berkeley Chancellor's Office and a few unrestricted gifts, we seek to diversify our sources of revenue to reduce the risk inherent in relying heavily on a single income stream. In the next year, we aim to fortify our base of revenue through expanding our membership program, seeking grants and research gifts, and exploring other opportunities for long-term revenue growth.

CITRIS has engaged with industry partners since its founding in 2001, when we exceeded the state-required matching goals to establish it as one of four UC Institutes for Science and Innovation. Since then, corporate and institutional partnerships have operated under a variety of frameworks and have largely relied on personal relationships with CITRIS faculty or leadership. We now aim to revise and consolidate the membership model to strengthen industrial and institutional partnerships and better articulate mutual benefits. The new model will create clearer avenues for organizations to become familiar with our research strengths and discover opportunities for collaboration. In addition, we will nurture a more robust program for undergraduate and graduate students in order to facilitate corporate investment and recruiting.

In response to globalized IT challenges, we want to expand the international impact and footprint of CITRIS. This process will be considerably enhanced through collaboration with global corporations and institutions. With three successful partnerships in place – DASTI (Denmark), ITESM (Mexico), and IHI (Japan) – we intend to build on these models to engage additional prestigious organizations worldwide.

We propose a membership program designed to meet the needs of different companies and institutions. The following chart describes the overview of this architecture.

MEMBERSHIP PROGRAM

CITRIS Members

Access & Engage

Gain access and visibility among students and researchers in the CITRIS ecosystem. Explore opportunities for deeper relationships.

- Sponsor student-focused programs

- Logo placement

- Custom tour with presentation

- Host info session for students

- Opportunity for tailored workshops to explore research synergies

- Opportunity to sponsor CITRIS events for broader audiences

CITRIS Partners

Research & Innovate

Collaborate on specific research projects or entrepreneurship programs while participating in their guidance and direction.

- Tailored workshops to explore research synergies

- Sponsor research students and/or a seed-funded project

- Visiting Fellow or Visiting Entrepreneur Program

- Seat on relevant Scientific Advisory Boards

- Opportunity to access relevant labs and test beds

7 CONCLUSION

As CITRIS celebrates its fifteenth anniversary, we recognize CITRIS faculty, staff and students as among the most creative and dedicated members of the UC community. CITRIS facilities at all four campuses enable cutting-edge research and technology development every day. With efforts to organize fresh research themes, foster innovation and entrepreneurship, and stabilize our base of support, we intend to continue contributing information technology discoveries in the interest of society for the next fifteen years and beyond.
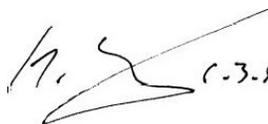
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