NCSA VISION 2020
A strategic plan for the National Center for Supercomputing Applications as an engine for 21st century research, education, and innovation.
It’s Time to Change the World Again
Our Vision is that NCSA will transform into a world-class, integrative center for transdisciplinary convergent research, education, and innovation.

NCSA will become a home for addressing complex research problems in science and society, powered by the development and application of advanced and comprehensive digital environments. NCSA will lead research partnerships that produce innovation and fuel economic expansion in Illinois and the nation.

NCSA and the University of Illinois have always been a nexus for innovation and change—NCSA's very creation in 1986 as a national hub for digital inquiry and exploration represented a revolution in the culture and conduct of research.

Today we again see profound challenges and exciting opportunities, leading us to the conclusion that it is time to change the world again.
Transdisciplinary digital convergence is a new paradigm of research in which multiple disciplines, research techniques, and enabling cyberinfrastructure combine to create a fundamentally new and extremely powerful mode of investigation.

NCSA—joining its advanced digital capabilities and expertise with the strengths of other Illinois units—can be a hub around which all of these elements converge.
“As scientific problems become yet more complex, interdisciplinarity moves to a new level… The most difficult problems do not respect disciplinary boundaries… convergent science [integrates] insights and approaches from many fields… barriers to convergent science [must be removed].”

In 2014, the National Research Council issued a report called Convergence: Facilitating Transdisciplinary Integration of Life Sciences, Physical Sciences, Engineering, and Beyond.
Complex Grand Challenges: An Example

The U.S. Midwest is the largest food producer in the world. Current typical agricultural practices have a detrimental impact on the Mississippi Basin and Gulf of Mexico, as fertilizer runoff causes nitrogen hypoxia—essentially, leaving a large “dead zone” in the Gulf. Extensive data on land usage, fertilizer runoff, water flows, crop genetics, and many other factors affecting the growth of crops and its environmental impacts are being collected, and need to be interpreted and acted upon.
Sustainable Food Growth

How can U.S. farmers best grow plants to feed the world while reducing negative environmental impacts?

This is one motivating grand challenge problem for NCSA’s thematic areas, crossing Earth and Environment, Bioinformatics and Health Sciences, Culture and Society, and Computing and Data Sciences. This challenge and others like it require expertise and engagement from multiple disciplines and also demand fundamental advances in the underlying methodologies of how we derive meaning from massive quantities of data and how we integrate modeling of phenomena at multiple scales.
Transdisciplinary Teams

NCSA is a place where these transdisciplinary teams can unite and where the necessary technological advancements will be made.
Transform NCSA into a world-class center for transdisciplinary research, education, and innovation
Create the world’s most advanced digital environment that integrates large-scale computing, instrumentation, and data services
Drive innovation, and economic, and societal impact for Illinois and the nation

GOALS FOR NCSA 2020
GOAL 1
NCSA as a Research and Education Center for Transdisciplinary Convergence

Astronomy and Physics
Led by Athol Kemball
NCSA, Astronomy

Bioinformatics and Health Science
Led by C. Victor Jongeneel
NCSA, Woese Institute for Genomic Biology, Bioengineering

Culture and Society
Led by Donna Cox
NCSA, Art and Design

Earth and Environment
Led by Shaowen Wang
NCSA, Geography and GIS

Computational and Data-enabled Science
Led by Gabrielle Allen
NCSA, Astronomy

Materials and Manufacturing
Led by Narayana Aluru
NCSA, Mechanical Science and Engineering
We envision NCSA as both a national center and an integral part of the Illinois campus. By combining NCSA’s expertise in the development and application of advanced computing and data services, techniques, and algorithms with Illinois’ strengths in research and education, the university can address convergent grand challenge problems, with high impact for the campus, region, and nation. Through deep, sustained collaboration with other areas of excellence on campus, NCSA can help power the university to excel as a national leader in computational and data-enabled research and education.

Essential to this vision is creating a compelling intellectual environment at NCSA so that faculty, staff, students, industrial partners, and other collaborators will see NCSA as the intellectual and digital environment where they can take on challenges and advance knowledge in ways they cannot elsewhere on campus or in the world. This environment will provide essential experience that will prepare a new generation of researchers and students for these challenges.

The initial thematic research areas around which NCSA is developing this environment of creativity and innovation are:

- **astronomy and physics**
- **bioinformatics and health science**
- **computational and data-enabled science**
- **culture and society**
- **earth and environment**
- **materials and manufacturing**.

Advances in these and other new areas will be powered through integration with the nation’s most advanced compute- and data-intensive production facilities and instruments and with experimental laboratories and facilities.

As of September, 2015 NCSA has:

- **15** CORE FACULTY
- **43** FACULTY AFFILIATES
- **11** NCSA STAFF WHO ARE RESEARCH OR ADJUNCT FACULTY

...and growing!

- African-American Studies
- Aerospace Engineering
- Art & Design
- Astronomy
- Atmospheric Science
- Beckman Institute
- Bioengineering
- Business
- Chemical & Biological Engineering
- Chemistry
- Civil & Environmental Engineering
- Communication Department
- Computer Science
- Crop Science
- Dance
- Educational Psychology
- Electrical & Computer Engineering
- Fine & Applied Arts
- Geography & GIS
- Labor & Employment Relations
- Library & Information Science
- Mechanical Science & Engineering
- Molecular & Cellular Biology
- Music
- Nuclear, Plasma, & Radiological Engineering Physics
- Plant Biology
- Political Science
- Urban & Regional Planning
- Woese Institute for Genomic Biology
Driven by convergent grand challenges in science and engineering, in the arts and humanities, and in industry, NCSA will pioneer an innovative digital fabric that integrates the world’s most advanced computational systems, data analysis and visualization tools and services, instruments, and technical expertise. Leveraging its continuing national leadership in provisioning the most powerful computational and data-intensive resources, NCSA will also lead Illinois to develop a world-class 21st century digital campus for research, education, and innovation.

Deep integration is critical to convergent research. Building on its history of developing world-leading computing environments, leveraging its unique university-based computing facility and expertise, and forging national and Illinois academic and industry partnerships, NCSA will:

- Continue its leadership in building the world’s most advanced computing systems
- Build world-class expertise in data science and develop algorithms, tools, techniques, software, and technologies
- Establish leadership in data services, working with communities to develop services for both large projects and the “long tail of science,” including services to integrate research data with publications, supporting reproducible, extensible research
- Create a unique environment to empower collaborative communities to address convergent, transdisciplinary problems
- Build on this environment to attract, retain, and further develop expert professional staff, faculty, postdocs, and students
This integrated environment will be developed at **campus, regional, and national scales**. To achieve this, NCSA will:

- Work with government agencies, partners, and projects to develop and deploy systems to support the nation’s leading research communities
- Seek to lead national projects and to develop unique capabilities that integrate computing, networking, and data environments
- Partner across the region—with the Illinois system, other universities, and national labs—to create an unparalleled digital environment for research, education, and innovation in the digital era, supporting our land-grant mission as an engine of innovation for the state

- Partner with university colleges, institutes, libraries, and IT organizations to create the nation’s leading 21st century digital campus, powering Illinois to lead nationally in addressing transdisciplinary convergent research, education, and economic development

It’s also essential to create a **layer of innovation** at NCSA. We envision NCSA as not just the home to the world’s most advanced production resources and services, but also as the cutting-edge experimental environment where the future of computational and data-enabled science and engineering is invented. The most advanced cyberinfrastructure technologies will be prototyped, tested, and used by leading researchers from all disciplines. This will be supported by activities such as the Innovative Systems Lab, Advanced Visualization Lab, and NDS Labs, which will be driven both by national communities and the NCSA thematic research and education areas.
NCSA will expand its innovation, economic, and societal impact activities by leveraging the expertise and energy of NCSA’s faculty affiliates, postdocs, students, and staff and partnering with other campus units and with local and national industry to become a key driver of the powerful Illinois economic engine.

To achieve this, NCSA will:

- Create offerings around development of data analysis services and tools and software codes
- Work with private sector and agency partners to define the comprehensive, integrated data and compute solutions that are needed to address complex problems
- Become a site for technology companies to both deploy and test new technologies at all scales with expert teams of faculty, students, staff
- Join with other campus units—such as the Computational Science and Engineering program and the Applied Research Institute—to drive the economic impact for the State of Illinois
- Develop entrepreneurship programs at NCSA in collaboration with campus
- Work closely with advancement and government relations offices across campus to build NCSA brand with important stakeholders