QUANTITATIVE LIFE SCIENCES INITIATIVE

Activity Report

A University of Nebraska Program of Excellence

2016–2018

bigdata.unl.edu

Welcome to the Quantitative Life Sciences Initiative

The Quantitative Life Sciences (QLS) Initiative is a university-wide, faculty-driven program to develop resources, expertise, and opportunities in data science for the life sciences. Established in 2013 with support from a University of Nebraska Program of Excellence, the Initiative conducts and coordinates data science research and training towards the advancement of knowledge of genes, complex cell processes, and ecosystems. QLSI faculty, postdoctoral scholars, and students explore the application of this knowledge to sustainable agriculture and improved health and well-being via data processing, transfer, and storage to novel analyses of large, complex data sets. The QLS Initiative is involved in several national and international programs including the Big Data Hubs and the North American and International Plant Phenotyping Networks.

The Initiative strives to establish new cross-campus linkages via data science, enabling transdisciplinary research, training and consulting with partners from academia, industry, and government. The Initiative works to raise awareness and use of the Bioinformatics Core Research Facility within the Center for Biotechnology through staff support, promotion and workshops; and provide education and resources for reproducible research (e.g., ORCiD, CyVerse) with University of Nebraska libraries and the Holland Computing Center.

The Priority areas identified for the Quantitative Life Sciences Initiative, specified in cooperation with the Office of Research and Economic Development, the Agricultural Research Division, and members of the Big Data Consortium include the following:

-Raise awareness and use of the Bioinformatics Research Core Facility

-Provide education and resources for reproducible research with UNL libraries and the Holland Computing Center

-Support faculty research and postdoctoral hires in the life and data sciences

-Develop an undergraduate program in data science in cooperation with other campus units

-Provide life science researchers with analytical and computational expertise for external proposal development

THE QLSI IS SUPPORTED BY A UNIVERSITY OF NEBRASKA PROGRAM OF EXCELLENCE AWARD.

https://bigdata.unl.edu

QLSI Members

Jennifer Clarke, Ph.D.

DIRECTOR, PROFESSOR, FOOD SCIENCE, STATISTICS

B.A., Psychology, Skidmore College; B.A., Mathematics, Skidmore College; M.S., Statistics, Carnegie Mellon University, Ph.D., Statistics, The Pennsylvania State University

Research Area: Statistical methodology (with an emphasis on high dimensional and predictive methods), statistical computation, multi-type biomedical data analysis, and data mining/machine learning.

Lisa Lightner

BUSINESS ASSOCIATE

Associates Degree, Environmental Technology, SECC; B.A., Journalism, University of Nebraska–Lincoln

Dmitri Fomenko, Ph.D.

RESEARCH ASSISTANT PROFESSOR, BIOCHEMISTRY & REDOX BIOLOGY CENTER

M.S., Biotechnology, Academy of Fine Chemical Technology, Russia; Ph.D., Molecular Biology, Institute of Molecular Genetics, Russian Academy of Sciences

Research area: Set of ER thiol oxidoreductases and selenoproteins with unknown function, which are associated with various disorders (cancer, mental retardation, cataract, diabetes, etc. and the roles and mechanism of hydrogen peroxide mediated signaling. Study of cysteine-rich glutaredoxin proteins in plants.

Zheng Xu, Ph.D.

RESEARCH ASSISTANT PROFESSOR, STATISTICS

B.Econ., International Economics, Fudan University, Shanghai, China; M.Sc., Applied Economics, Illinois State University; Ph.D., Statistics and Economics, Iowa State University; Postdoc., Biostatistics and Genetics, University of North Carolina at Chapel Hill

Research area: Machine Learning, Computation, Statistical Prediction and Inference Biostatistics, Statistical Genetics, Genetic Epidemiology, Bioinformatics, Genome Structure Integrative Data Analysis, Plant Image Phenotyping.

Qidong Jia, Bioinformatician/Computational Biologist, Center for Biotechnology

Research area: Bioinformatics and comparative genomics; gene post-transcriptional and translational regulation; and plant secondary metabolism.

Hengle Jiang, Web & Database Analyst, Holland Computing Center

Research area: Software engineering, web & database design and bioinformatics working on Data Management & Analysis Core (DMAC) under the Nebraska Center for Integrated Biomolecular Communication (NCIBC), developing a flexible and loose coupling component-based software system for large-scale high-throughput biochemical and biomedical data.

Manas Khan, Biological Systems Engineering

Research area: Spatiotemporal Suitability of Hydroclimate Analytics for Local to Regional Resilient Agriculture

Zhikai Liang, Graduate Research Assistant, Agronomy & Horticulture

Research area: Plant phenomic and genomic data analysis.

Chia Sin Liew, Bioinformatician/Computational Biologist, Center for Biotechnology

Research area: Applications of bioinformatics in biological research, specifically approaches that integrate multi-omics data.

Francisco Munoz-Arriola, Assistant Professor of Hydroinformatics and Integrated Hydrology

Robert B. Daugherty Water for Food Institute Fellow

National Science Foundation-Enabling the Next Generation of Hazards and Disasters Researchers

American Meteorological Society/National Science Foundation-Summer Policy Colloquium

Research area: Data Science, Integrated Hydrology (nexus water quality-quantity), Resilient Complex Systems, Predictability of Hydrometeorological and Climate Extremes, Nexus Water-Food-Energy-Ecosystems Services in a Changing Environment, Phenotype predictability, Global Water System

Thomas Payne, Bioinformatician/Research Associate, Center for Integrated Biomolecular Communications

Research area: Modelling and interpretation of high dimensional nuclear magnetic resonance spectroscopy and mass spectrometry data for application in metabolomics, lipidomics and proteomics, and the ultimate goal of precision medicine.

James Schnable, Assistant Professor Agronomy and Horticulture; Center for Plant Science Innovation; Nebraska Food for Health Center ; Quantitative Life Sciences Initiative.

Research area: Computational Biology, Multispecies functional genomics and High throughput phenotyping

Awards:

March 2017, Ruth Branham Agricultural Research Fund Junior Faculty Excellence in Research for employing new methods to combine phenotypic and functional genomic data from both domesticated grain crops (corn, sorghum, sugar cane, prose millet, foxtail millet, etc.) and their wild relatives.

July 2017, collaboration on a million dollar ARPA-E Award (Advanced Research Projects Agency-Energy) with Iowa State University (ISU) researchers to develop and test a new low cost nitrogen sensors in the field.

March 2018, Marcus Rhoades Early Career Award for contributions to the genetics and genomics of maize and allied species.

July 2018, awarded a Rules of Life Grant from the National Science Foundation to investigate the evolutionary and genomic basis of increasing morphological complexity in multicellular organisms.

October 2018, as part of a team with researchers at the University of Nebraska and HudsonAlpha in Alabama, awarded a $4M grant from the National Science Foundation to using comparative genomics, genome editing, and high throughput phenotyping to re-engineer how sorghum responds to nitrogen stress.

October 2018, finalist for the 2018 Tansley Medal, awarded by the New Phytologist Foundation in recognition of an outstanding contribution to research in plant science by an individual in the early stages of their career.

UNL Oversight

Administration

Bob Wilhelm,
Vice Chancellor for Research and Economic Development
Professor of Mechanical Engineering

Archie Clutter,
Dean/Director, Agricultural Research Division; Animal Science

Curtis Weller,
Chair; Director, Food Science and Technology

Corey Cook,
Director, Business Center, FDST

Faculty

Stephen Scott
Professor and Vice Chair, Computer Science and Engineering

David Swanson,
Director, Holland Computing Center;
Research Professor, Computer Science and Engineering

Stephen Kachman,
Professor of Statistics

George Avalos
Professor of Mathematics

Etsuko Moriyama,
Professor, School of Biological Sciences; Center for Plant Science Innovation

Heriberto Cerutti,
Professor, Biotechnology; Professor, School of
Biological Sciences

Andrew Benson,
W.W. Marshall Professor, Food Science & Technology,
Director, Nebraska Food for Health Center

Khalid Sayood,
Professor, Electrical Engineering

QLSI on the web

Twitter: @UNLBIGData

Online: **bigdata.unl.edu**
Research Areas, News & Events, Resources & Tools, and Careers

Quarterly Electronic Newsletter
The Big Data Report: Current news, Big Red Ideas, Big News, Big Events, Big Opportunities, Big Resources

Available via LISTSERV.UNL.EDU

BIGDATACONSORTIUM

UNLBIOINFO

BIGDATAREPORT

Quantitative Life Sciences Initiative

Partner Organizations

The QLSI has developed initial partnerships with both academic and industrial organizations with shared interests in data science and Big Data in scientific research and education. These partners share their domain knowledge and expertise, and the challenges they face engaging the talent they require to continue their success.

LI-COR

Iowa State University

Corteva agriscience

University of North Dakota

Bayer CropScience

Kansas State University

North American Plant Phenotyping Network NAPPN

University of Michigan

International Plant Phenotyping Network IPPN

Midwest Big Data Hub

ASA American Statistical Association Promoting the Practice and Profession of Statistics

UNMC

QUANTIFIEDAG

indigo

Mutual of Omaha

IASSIST International Association for Social Science Information Services & Technology

Greater Western Library Alliance

Education

Complex Biosystems PhD Program

The PhD Program in Complex Biosystems (CBIO) started in 2015, is designed to prepare students for a broad range of careers that integrate quantitative and computational approaches to data acquisition and analysis in multiple fields of the life sciences. Specializations include Microbial Interactions, Integrated Plant Biology, Pathobiology and Biomedical Science, Systems Analysis, and Computational Organismal Biology, Ecology and Evolution (COBEE). Faculty members from across four colleges participate in the training of future scientists who can leverage skills from the data and life sciences to address research and societal challenges.

Graduates from this program have rigorous training in the application and underlying concepts of quantitative and life science research methods, critical literature evaluation, scientific presentation, grantsmanship, and professional skills. In addition, students have exposure to teaching in the life sciences and mentored graduate research that encompass quantitative approaches and life sciences. With the rising prominence of large data sets in life sciences research, conventional notions of how research is conducted and what it will look like going forward has attracted students looking for a transformational step toward the next tier in life sciences scholarship and education.

To apply, submit an application with the office of graduate studies:
https://wam.unl.edu/gradstudies/apply

For general questions about applying contact:
Jennifer Clarke at jclarke3@unl.edu
Amanda Ramer-Tait at aramer-tait2@unl.edu
Joshua Herr at jherr@unl.edu

For more information about the graduate studies program, please visit our website at **bigdata.unl.edu/phd-program**.

Current Student Listing:
Undergraduate Institution, Area of Focus, Advisor, Department

(2016)

Kimberly Stanke, Michigan Technological University, Mathematical Modeling of Biological Systems, Brain Metabolism, Kidambi & Khalimoncuk / Chemical and Biomolecular Engineering & Biochemistry

Ashley Stengel, University of Utah, Microbial Ecology, Agricultural Soils, Bioinformatics, Drijber & Herr / Agronomy and Horticulture, & Plant Pathology

Bridget Tripp, Old Dominion University, Probabilistic Graphical Models, Data Integration, Computational Biology, Otu / Electrical and Computer Engineering

(2017)

Sarah Johnson, Winthrop University/University of Georgia, Plant Molecular Genetics

Aimee Kessell, University of Nebraska - Omaha, Metabolic Modeling, Immunology, Virology, Helikar / Biochemistry

Nate Korth, University of Nebraska - Lincoln, Associations between plant genetics and perturbation of the human gut microbiome, Benson & Schnable / Food Science & Agronomy

Michael Morikone, California State University San Bernardino, Bioinformatics, -omics, Gene Expression, Amundsen / Agronomy and Horticulture

Amanda Quattrone, Louisiana State University, Plant Diversity/Phylogeny, Plant Soil Feedbacks, Microbial Communities, Russo/ School of Biological Sciences

Rafael Segura Munoz, Universidad de La Sabana, Colombia, Microbial Ecology, Bioinformatics, Mathematical Modeling

Yu Shi Nanchang University, Bioinformatics, Multi-omics Data Integration, Zhang / School of Biological Sciences

(2018)

Ema Graham, University of New Haven, Virology, Forensic Sciences, Population Genetics, Adamowicz & Fernando/ Animal Science

Katherine LaTourrette, Oberlin College, Plant Pathology, Evolution of Pathogen-host Interactions, Rotating Moriyama, Cui, and Garcia-Ruiz Labs

Dianna Long, Truman State University, Synthetic Biology, Bioproduction, Metabolic Modeling of Microorganisms, Rajib Saha, Chemical and Biomolecular Engineering

Hugh McCullough, Michigan State University, Human Gastrointestinal Microbiomes, Rotating NFHC / Food Science and Technology

Zhikai Yang, Northwest A&F University, Quantitative Genetics, Jinliang Yang/ Department of Agronomy and Horticulture

Broadening Participation, Increasing Diversity

BRAID: BUILDING, RECRUITING, AND INCLUSION FOR DIVERSITY

The BRAID Initiative, led by the Anita Borg Institute, is a partnership of academic institutions across the nation to increase the percentage of women and students of color majoring in computer science. UNL is proud to be a participating institution. Our undergraduate computer science program is one of 15 across the United States that have joined this nationwide initiative to recruit more women and underrepresented minorities to the computer science field.

BRAID Building Recruiting And Inclusion for Diversity

Student Involvement

2018 Widaman Distinguished Graduate Assistantships

Ashley Stengel

Awarded in recognition of outstanding performance as a graduate student for her research on Exploring Ecosystem Resiliency: soil bacterial communities at a long-term maize field site.

Rafael Segura Munoz

Awarded in recognition of outstanding performance as a graduate student for his research determining how specific members of the gut microbiota interact with one another to promote the health benefits associated with eating dietary fiber.

Taylor Horn from Baylor University, Nebraska REU student, Summer 2016

Summer Research Program is a consortium of NSF funded Research Experiences for Undergraduates (REU) and other summer research opportunities program (SROP)...summer research experience provides mentoring and research experiences while allowing scholars to preview graduate school life. Students with a strong interest in graduate programs are particularly encouraged to apply, as are those from populations traditionally underrepresented in graduate education.

High School event at UNL on Cloud Computing, March 2018

Students from Aurora High School in Nebraska participating in the 'Future Problem Solving' State Bowl made a stop at UNL to learn about Cloud Computing.

Midwest Big Data Summer School for Early Career Researchers, Iowa State University, 2017/2018

The QLSI supported groups of Complex Biosystems students in 2017 and 2018 to attend lectures on topics ranging from: data acquisition, data preprocessing, exploratory data analysis, descriptive data analysis, data analysis tools and techniques, visualization and communication, ethical issues in data science, reproducibility and repeatability, and understanding of domain/context with individual tracks focusing on Foundations of Data Science, Software Analytics, and Digital Agriculture.

Nebraska Data Analytics (NeDA), Spring 2017

Hosted by the Department of Computer Science and Engineering (CSE) at the University of Nebraska-Lincoln

The Nebraska Data Analytics Workshop explored collaborations for data analytics between CSE faculty and regional organizations, bringing together Informatics and Algorithmic Foundations (IAF) group of faculty and regional organizations to discuss emerging challenges, solutions, and opportunities in data analytics.

2016 Early Career Big Data Summit (ECBDS)

PhD. students Bridget Tripp, Ashley Stengel, Kimberly Stanke, and former student Carrie Brown, received the grand prize for application development of On Demand Taxonomic Reference Database Compilation for genome sequencing and third place with their K-12 educational video, The Omics of Big Data, The event was hosted by the University of North Dakota and the Midwest Big Data Hub.

Kimberly Stanke

2018-2019 Milton E. Mohr fellowship

Based on her academic performance and potential for accomplishments in biomedical engineering, Stanke was one of a select group of PhD students invited to attend the NIH BRAIN Initiative Summer Course on Models and Neurobiology in the summer of 2017 at the Computational Neurobiology Center at the University of Missouri.

Nate Korth

Nebraska Food For Health Graduate Fellow

research in the associations between plant genetics and perturbation of the human gut microbiome. NFHC students are recruited through the Complex Biosystems program. The Complex Biosystems program embodies the combination of interdisciplinary research and quantitative and computational approaches that are heavily emphasized in the Nebraska Food for Health Center.

Curricula

Informatics Minor

The Informatics minor is an interdisciplinary program that prepares students with core computational skill sets and competencies that allow them to solve problems within their chosen discipline or field. The program also builds interdisciplinary problem solving skills that are applicable and advantageous across academia and within industry. The minor's objectives are anchored around a set of core outcomes designed to:

-Apply computational thinking to solve problems effectively and implement it using a programming language;
-Apply statistical techniques to assess outcomes of empirical studies or experiments, and set up research designs to evaluate tools, techniques or hypotheses effectively;
- Interact, use and manage data or databases and solve data-centric problems; or organize, visualize, and communicate digital data effectively and efficiently; or use creative competencies to generate creative solutions;
-Contribute one's expertise to the solution of interdisciplinary problems by effectively collaborating and communicating with those from other disciplines.

For more information about the Informatics Undergraduate Minor: **bulletin.unl.ed/undergraduate/major/Informatics+Minor.**

Outreach & Engagement

Events

UNL Plant Science Retreat, Oct 2018, Lied Lodge and Conference Center, Nebraska City, Ne

Supported in part by the initiative, the event is a biennial event for members of the University of Nebraska

Plant Science Community, giving them a forum to hear and discuss the latest in Plant Science research. This retreat is sponsored by the Center for Plant Science Innovation, with funding from UNL departments and additional sources. Keynote speakers included Dr. Nirav Merchant, Director, University of Arizona, Data Science Institute, "Learning (for all of us) in the machine learning era", Dr. Hasan Otu, Professor, University of Nebraska-Lincoln, "Network analysis of multiomic data using probabilistic graph representations" and Dr. Eric Deeds, Associate Professor, University of Kansas, "The Evolution of crosstalk in signaling networks"

Supercomputing and Life Sciences Symposium, March 2018, Wick Alumni Center, Lincoln, Ne

The Holland Computing Center and the Quantitative Life Sciences Initiative partnered to host the 2018 Supercomputing and Life Sciences (SLS) Symposium, bringing speakers on computational sciences from across the nation and within the NU system with topics in high-performance computing and quantitative life sciences research attracting computational as well as life science faculty and students in a broad range of STEM fields. The symposium featured experts from CyVerse, Internet2 and Center for the Advancement of Data and Research in Economics as well as posters covering research relevant to the QLSI mission and/or benefiting from advance computing (e.g. use of HCC, the Open Science Grid or XSEDE resources).

CyVerse hackathon 2017&2018

CyVerse hosted a three-day plant and crop phenotyping hackathon at the BIO5 Institute at the University of Arizona (UA) following the Phenome 2017 conference in Tucson, Arizona to tackle projects including improving data collection from unmanned aerial vehicles (UAVs), improving data and metadata management practices, and developing strategies for leveraging Open Science Grid (OSG), a National Science Foundation and Department of Energy project that aims to facilitate access to distributed high-throughput computing resources for U.S.-based researchers. The series continued in 2018 with an emphasis on "how we collect and organize data, how we process it, and how we use it to develop statistical and conceptual frameworks to understand biological complexity, from molecular to ecological scales."

Datapalooza 2017

Hosted by UNL's Quantitative Life Sciences Initiative, Holland Computing Center and the Department of Statistics, the event brought together teams of undergraduates from Computer Science & Engineering, Sociology, Actuarial Science, Mathematics, Biochemistry and Business Analytics at the University of Nebraska-Lincoln to compete in a two-day event to discover meaning from the Genomes To Fields (G2F) project hosted by Data Commons. The data which consisted of hybrid and inbred agronomic and performance traits and inbred genotypic data is part of an open source umbrella initiative to develop approaches to understand the functions of corn genes and specific alleles across environments.

Machine Learning/Farm to Table, University of Illinois Urbana-Champaign w/ International Food Security Symposium, April 2017

In April, the Midwest Big Data Hub (MBDH), the International Food Security at Illinois (IFSI) and scientists from the Agriculture, Bioinformatics, Food-Energy-Water, and Food Security communities, along with computational experts convened in an effort to stimulate new data-driven R+D activity at the intersections of these communities.

Keynote speakers included Pat Schnable (Iowa State University), "Challenges Facing Crop Production and the Potential of High-Throughput, Field-based Phenotyping" and Ranveer Chandra (Microsoft Research), "FarmBeats: AI & IoT for Agriculture". Additional activities involved a panel on Machine Learning Opportunities/Challenges, breakout sessions covering topics in Crops and Water, Food Processing and Nutrition, International Food Security, Big Data and Animal Sciences, Data privacy/data security/data sharing and a round of lightning talks demonstrating machine learning - machine learning applications.

The workshop was supported by the Midwest Big Data Hub (MBDH), a growing network of partners investing in data and data sciences to address grand challenges for society and science through a grant from the National Science Foundation.

International Plant Phenotyping Symposium, Adelaide, South Australia, October 2-5, 2018

Phenome, Tucson Az, February 2019

NIFA Summit- Big Data in Ag, Chicago, Ill, October 10, 2016

North American Plant Phenotyping Network , Purdue, August 29-31, 2016

Presentations

Streaming Science, an undergraduate, student-driven, project-based learning science literacy program at the University of Nebraska-Lincoln (UNL) was designed to introduce public audiences to real-world scientists and critical agricultural and environmental research.

Over the 2018 spring semester, the Quantitative Life Sciences Initiative worked with Agricultural and Environmental Sciences Communication students to highlight the importance of data science. In all, students produced ten podcasts with UNL colleagues in the field whose work centers around big data.

Big Data Play List: https://soundcloud.com/streaming-science/sets/big-data

IEEE conference 2017

The IEEE International Conference on Bioinformatics and Biomedicine (BIBM) established as the premier research conference in bioinformatics and biomedicine provides a leading forum for disseminating the latest research in bioinformatics and health informatics. It brings together academic and industrial scientists from computer science, biology, chemistry, medicine, mathematics and statistics.

"When technology meets technology: Retrained 'Inception V3' classifier for the NGS based pathogen detection" Rohita Sinha ; Jennifer Clarke, Published in: 2017 IEEE International Conference on Bioinformatics and Biomedicine

Great Plains Network Webinar Series: Preparing a Funding Proposal to NSF Big Data, 2017

08/18/17: BDH Solicitation: Class 3 – Budget & Budget Justification, Greg Monaco and Jennifer Clarke

08/04/17: BDH Solicitation: Class 2- Project Description: Project Plan, Timeline, Metrics for success, Greg Monaco and Jennifer Clarke

07/28/17: BDH Solicitation: Class 1 – Overview & Project Summary: What do you hope to accomplish and how will this contribute to the BD Hubs, Greg Monaco and Jennifer Clarke

06/09/17: NSF Big Data Hub Projects: Overview and Getting a Hub Letter of Collaboration by June 19, 2017, Greg Monaco and Melissa Cragin

Visiting Scholar

Stephen Gerth, Fraunhofer Institute for Integrated Circuits, Furth, Germany, "Computed Tomography at the Fraunhofer EZRT Applied for Digital Phenotyping" April 2017

Mini land grant mtgs, Agricultural Research Stations and USDA, Purdue, July 24-25, 2017

International Association for Social Science Information Services and Technology, University of Kansas, May 23-26, 2017

Phenome, Tucson Az, February 2017, 2018

North American Plant Phenotyping Network , Purdue, August 29-31, 2016

Webinars

Metagenomics Mondays, Fall 2018...UNL and Iowa State

Microbial communities have a strong impact on all aspects of life on earth, including agriculture, human and animal health, and in all ecosystems. At UNL, ISU and beyond, challenges and opportunities in microbiome research are being addressed using novel approaches from diverse disciplines. Researchers working in this area are in animal science, biosystems engineering, plant pathology, agronomy, veterinary medicine, and others. This seminar series hosted speakers from veterinary sciences, plant sciences, microbiology, statistics, data science, engineering and more.

Unmanned Mondays, Spring 2018

Hosted by The Digital Agriculture Spoke of the Midwest Big Data Hub, NSF BDSPOKES - Digital Agriculture: Unmanned Aerial Systems, Plant Sciences and Education (UASPSE), the webinar series featured speakers from academia and industry to discuss and introduce participants to UAS data analysis software and algorithms, metadata standards, and best practices, with a goal of harmonizing UAS data access, reproducibility and reuse across institutions and industry.

Plant Phenomics Phridays, Fall 2017...UNL and Iowa State

The Midwest Big Data Hub Digital Agriculture Spoke and the University of Nebraska Quantitative Life Sciences Initiative hosted a fall research seminar series: Plant Phenomics Phridays. This is a continuation of the summer series hosted by Iowa State University. The series of weekly seminars addressed challenges and opportunities in the plant sciences using novel approaches from diverse disciplines. Speakers in this seminar series included statisticians, biologists, data scientists, and engineers.

https://bigdata.unl.edu/webinars

NSF Big Data Spokes Digital Agriculture: Unmanned Aerial Systems, Plant Sciences and Education

The Digital Agriculture Spoke of the Midwest Big Data Hub seeks to organize academic, industrial, and governmental sectors around the development of policies and best practices for data science and Big Data applications in agriculture, with a particular focus on automating the Big Data lifecycle for unmanned aircraft systems (UAS) and for plant sciences, phenomics, and genomics.MBDH Digital Agriculture All-hands Meeting, Iowa State,

Unmanned Aerial Systems, Plant Sciences/Plant Phenomics, and Education, Iowa State University, Ames, Iowa, Fall 2017

Keynote Speaker: Parag Chitnis, Deputy Director, USDA National Institute of Food and Agriculture (NIFA)

"Data Science for Transforming the U.S. Food System"

MBDH All Hands Meeting, Kiewit Innovation Center Omaha, Nebraska, Data-enabled Midwest Resilience, Oct 2017

Organized annually bringing together MBDH membership and interested parties to share information on data and data science related projects, collaborations, tools, practices, and discoveries in the thematic areas of interest in the MBDH region.

Big Data Hub/CSIRO, Canberra, Australia, July 10-14, 2017

MBDH All Hands Meeting, Rosemont, Illinois, March 21-22, 2016

University of Nebraska-Lincoln

The meeting, established by the Midwest Big Data Hub Digital Agriculture Community, a growing network devoted to building partnerships and resources to address emerging issues in precision agriculture, ecosystem management and services, biosciences, socio-economic impacts, and data-related issues in the agricultural ecosystem, focused on the methodologies and technologies that enable Digital Agriculture, the associated data challenges, and the resulting insights into complex agricultural and agroecological systems.

Several ongoing projects among biologists, engineers, computer scientists, and allies encompassed UAS systems, plant sciences, and the future of education in agriculture. These projects emphasized how we collect and organize data, how we process it, and how we use it to develop statistical and conceptual frameworks to understand complexity in agricultural systems, from molecular to ecological scales.

In addition to the meeting, a one-day, hands-on 'Flight to Maps: workshop on unmanned aircraft remote sensing' and the use of UAS systems, basic data acquisition and processing was held at the Eastern Nebraska Research and Extension Center (ENREC) near Mead, Nebraska.

Led by Wayne Woldt, Ph.D., P.E., Extension Specialist - Unmanned Aircraft Near Earth Remote Sensing, Director – NU-AIRE Unmanned Aircraft Innovation, Research and Education Laboratory, Biological Systems Engineering and School of Natural Resources

Jacob Smith, Flight Operations Director,N U-AIRE Unmanned Aircraft Innovation, Research and Education Laboratory,Biological Systems Engineering

Mitch Maguire, Graduate Research Assistant, NU-AIRE Unmanned Aircraft Innovation, Research and Education Laboratory, Biological Systems Engineering

https://bigdata.unl.edu/midwest-big-data-hub-digital-ag-all-hands-meeting

Lisa Harper, Plant Geneticist, USDA ARS
Keynote: AgBioData Consortium

James Wilgenbusch, Senior Associate Director
Minnesota Supercomputing Institute
Office of the Vice President for Research
University of Minnesota
Keynote: G.E.M.S. platform for agricultural data management

April Agee Carroll, Digital Greenhouse Lead
Bayer Crop Science
Adjunct Assistant Professor of Horticulture and Landscape Architecture, Purdue University
Chair, North American Plant Phenotyping Network

Carolyn Lawrence Dill, Associate Professor
Dept. of Genetics, Development and Cell Biology & Dept. of Agronomy Chair, Graduate Interdepartmental Bioinformatics and Computational Biology, Iowa State University

Aaron Bergstrom, Advanced Cyberinfrastructure Manager
University of North Dakota

Faculty Involvement

The caliber of QLSI rests on the involvement of talented and motivated members of the faculty. Over the past two years we have participated in the hiring of new faculty members with expertise in data and computation for the life sciences. We support faculty collaborations and communication through regular meetings of the Big Data Consortium, a group of faculty and students whose research involves life science data.

New Hires 2016–2018

Jennifer Auchtung, Assistant Professor, IANR, Food Science & Technology

Sophie Alvarez, Research Associate Professor, IANR, Agronomy & Horticulture, Center for Biotechnology

Katarzyna Glowacka, Assistant Professor, IANR, Biochemistry

H. Andrew Harms, Assistant Professor, ENG, Electrical and Computer Engineering - Omaha

Reka Howard, Assistant Professor, IANR, Statistics

Marc Libault, Associate Professor, IANR, Agronomy & Horticulture

Michael J. Naldrett Research Assistant Professor, IANR, Center for Biotechnology

Toshihiro Obata, Assistant Professor, IANR, Biochemistry

Ryan Pedrigi, Assistant Professor, ENG, Mechanical and Materials Engineering

Kurt Piepenbrink, Assistant Professor, IANR, Food Science & Technology

Yeyin Shi, Assistant Professor, IANR, Biological Systems Engineering

Alex Vecchio, Assistant Professor, IANR, Biochemistry

Rebecca Wachs, Assistant Professor, IANR, Biological Systems Engineering

Jinliang Yang, Assistant Professor, IANR, Agronomy & Horticulture

Yuhang Xu, Asst Professor, IANR, Statistics

Elizabeth VanWormer, Assistant Professor, IANR, Vet & Biomedical Sciences

Research

Consortium for Integrated Translational Biology

CITB mission statement

Create a transdisciplinary environment to address the genotype to phenotype gap through the development of integrative predictive models for the selection of valuable traits that address yield, protection of yield, and quality traits across plant species used for food, feed, industrial applications and landscape resources. This focus will be directed towards facilitating translation of innovations to the field.

Areas of Focus

Phenotyping, Genotyping, Trait Selection

Goal and Objectives

Initiatives and subsequent developed Centers serve as drivers for research and economic development by fostering collaboration among faculty across departments and colleges. This is exemplified in the activities within the Center for Plant Science Innovation (PSI). Wherein the faculty within the Center have participated in grantsmanship resulting in millions of dollars in funding which has been translated to high impact scholarly outputs and technology development. In regards to the latter the PSI has placed a strong emphasis on lab-to-field translational research activities with real world applications towards sustainable and improved agriculture production that impact farmers and consumers in Nebraska and globally. However, for UNL to fully capitalize on its investments in Centers, Initiatives and Departments it is imperative that synergies among these entities be identified and mechanisms put in place to foster and incentivize transdisciplinary research across these units. A prime example of transdisciplinary research potential lies in a strength within PSI, enhancing oil content and quality of oilseed crops.

This area of emphasis has opportunities for research interactions with the GUT Function Initiative, the Nebraska Gateway for Nutrigenomics, and UNMC to investigate impact of these novel lipids on a range of aspects of human and animal health. Moreover, these lipid modifications have value in feed and industrial applications wherein collaborative opportunities exist with the Food Processing Center, Red Meat Initiative, Industrial Agriculture Products Center and Tractor Engine Testing Laboratory. Another area of strength within PSI is stress tolerance. Recent investments in faculty hires and throughput phenotyping capacity will clearly add to this area of expertise, but to fully capitalize on these investments will require strong linkages with CALMIT, Computational Biology Initiative, faculty within SNR, BSE among others. The ability to create these linkages offers potential for development of predictive algorithms to aid in plant germplasm selection efficiency. These examples illustrate how a coordinated interactive unification structure that fosters linkages among Centers, Initiatives and Departments will build synergistic research activities in the life sciences across campus. This in turn will build upon UNL's national and international stature. However, for this vision to become reality strategic investments in research infrastructure and incentives to promote collaborative research programs will be required.

Daniel Schachtman, Director, Center for Biotechnology, Professor Agronomy & Horticulture
Vincent Stoerger, Plant Phenotyping Facilities Mgr, Agricultural Research Division
Yufeng Ge, Asst Professor, Biological Systems Engineering
Suat Irmak, Professor Biological Systems Engineering, Earth & Atmospheric Sciences
Hector Santiago, Asst Dean/Asst Director, Agricultural Research Division
Edgar Cahoon, Professor Biochemistry, Director Center for Plant Science Innovation
Tala Awada, Professor, School of Natural Resources, Associate Dean/Director, Agricultural Research Division
George Graef, Professor, Professorship Soybean Breeding, Agronomy & Horticulture

https://ard.unl.edu/research-teams/consortium-integrated-translational-biology-citb

Center for Integrated Biomolecular Communication

The Nebraska Center for Integrated Biomolecular Communication (NCIBC) is a UNL Center with funding through the NIH IDEA program.

The goals of the center are supporting research and career development; providing early stage investigators with research support and opportunities for career development broadly focused on understanding the regulation of biomolecular communication pathways, enhancing research capabilities, establishing a Systems Biology Core and a Data Management and Analysis Core by leveraging existing facilities and enhancing research capabilities, fostering research collaborations, pursuing high impact biomedial research through integrated interdisciplinary research collaborations and diverse disciplinary representation.

The initial cohort of project leaders – five early stage investigators from the Departments of Biochemistry, Chemistry, and Chemical and Biomolecular Engineering – are pursuing projects interrelated by their fundamental focus on different aspects of biomolecular communication within and between cells and tissues. These projects are directed toward identifying molecular metabolic signals of microbial syntrophy in the human gut, developing techniques for high-resolution protein glycoform analysis, unraveling ligand-Stabilin-2 interactions in liver disease progression, designing molecular probes for intracellular phosphorylation kinetics, and developing tissue engineering platforms specifically for liver. The breadth of science encompassed by these projects signifies the interdisciplinary nature of the Center's research goals.

NCIBC's Systems Biology Core and Data Management and Analysis Core facilities leverage existing core facilities established under prior COBRE support. The proposed research cores, coupled with the interdisciplinary focus of the NCIBC, will serve as a natural mixing chamber to foster the development of new collaborations among Nebraska's biomedical researchers to pursue high impact biomedical research.

James Takacs, Center Director
Concetta DiRusso, Center Co-Director
Robert Powers, Systems Biology Core Director
Jennifer Clarke, Data Management and Analysis Core Director
https://ncibc.unl.edu/about-cibc

NSF Big Data Hub

Accelerating the Big Data Innovation Ecosystem

In March 2012, the National Science Foundation announced the National Big Data Research and Development Initiative, which aims to solve some of the Nation's most pressing R&D challenges related to extracting knowledge and insights from large, complex collections of digital data. As part of the initiative, federal agencies, private industry, academia, state and local governments, non-profits, and foundations develop and participate in Big Data research and infrastructure development; education and workforce development; and multi-disciplinary collaborative teams and communities that address complex science and engineering grand challenges. To augment ongoing activities and to ignite new Big Data public-private partnerships across the Nation, the NSF Directorate for Computer and Information Science and Engineering is working to establish a National Network of Big Data Regional Innovation Hubs (BD Hubs). Four Hubs are being created across distinct geographic regions of the United States, representing the Northeast, Midwest, South, and West. Each Hub is a consortium of members that focus on key Big Data challenges and opportunities for its region of service (referred to as spokes and rings) with an aim to support the breadth of interested local stakeholders (referred to as the nodes) that would not be possible for the independent members to achieve alone. The Principal Investigator team for the Midwest hub consists of representatives from the University of Illinois Urbana-Champaign/NCSA, the University of Michigan, the University of North Dakota, the University of Indiana, and Iowa State University. The Steering Committee consists of representatives from Institutions that represent regional interests and specific subject matter areas in Big Data. Members of the Steering Committee include representatives from the University of Nebraska Lincoln (QLSI), the University of Kansas, Kansas State University, the University of Missouri, the University of Iowa, the University of Cincinnati, Wayne State University, Argonne National Labs, UI Labs, and the University of Chicago.

The University of Nebraska, with interests in Big Data relevant to agriculture and natural resources, physics, earth and atmospheric sciences, and data sciences, and its stakeholders are faced with the challenge of using Big Data to increase agricultural production. This challenge involves Big Data of several types, including imaging (remote sensing, plant phenotyping), cellular/genomic (high throughput sequencing), and autogenic (real time sensing and data collection). The large amounts of available data and their complexity require that regional partners agree on standards for data sharing, data access, and data stewardship, and provide shared resources and educational opportunities to the community. As a land-grant university in the Midwest region, UNL has a long history of extension and outreach, including partnerships with other institutions for both education and research. As such, UNL and QLSI are key participants in several rings and spokes of the Midwest Hub, including Digital Agriculture and Data Science. Specific industry partners involved in the early ages of Hub development in Nebraska include Li-Cor and the Nebraska Public Power District.

http://midwestbigdatahub.org

Bioinformatics Core

Center for Biotechnology Bioinformatics Core Research Facility

OBJECTIVES

The Bioinformatics Core Research Facility (BCRF) fosters cutting-edge, interdisciplinary, cross-campus and inter-institutional research in Bioinformatics and Computational Biology. Its efforts are focused on collaborations that are strategic to UNL, including emerging diseases, system biology, energy, environmental studies, virology, and translational medicine. The BCRF provides scientific expertise and core infrastructure support as well as education and training. Their expertise helps to integrate bioinformatics and biological sciences to facilitate efficient and effective research. The Core offers education, analysis, and computational services in the area of experimental design, data management and provides bioinformatics services:

Preparing for and writing of grant proposals that include life sciences related computation or analyses; Collaborate on larger projects and grants; Custom-program solutions (Java, Perl, VBA) for conversion or integration of data files and develop and program solutions for large-scale analyses; Lectures in bioinformatics topics; Install and maintain, in collaboration with the Holland Computing Center, up to date software and databases in the Life Sciences (specifically bioinformatics) domain; Support for bioinformatics software & analyses on the Holland Computing Cluster; Host (web) servers and research database-drives websites (e.g. species specific genome browsers).

The Bioinformatics Core Research Facility receives funding support from the Nebraska Research Initiative (NRI), the Program of Excellence in Computational Sciences, and the NIH via the Nebraska Center for Integrated Biomolecular Communication (NCIBC).

Director: Dr. Daniel Schachtman
Facility Directors:
Bioinformatics, Dr. Jean-Jack Riethoven
Plant Transformation, Dr. Thomas Clemente
Flow Cytometry, Dirk Anderson
Microscopy, Dr. You Zhou
Proteomics/Metabolomics, Dr. Sophie Alvarez

https://biotech.unl.edu/bioinformatics

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Upcoming Events

Phenome 2019: Tucson, Arizona, February 6-9, 2019

The 3rd annual Phenome 2019 conference represents a multidisciplinary community comprising plant biologists, ecologists, engineers, agronomists, computational scientists, and representatives from U.S. federal agencies who come together in a rich and diverse networking environment to foster collaboration, innovation, and the initiation of multi-investigator and multi-institution projects. Phenome 2019 will also serve as a platform to generate greater understanding about plants and climate change, bringing together preeminent international speakers.

Datapalooza: Spring, 2019

Hosted by the Holland Computing Center, University of Nebraska-Lincoln and Mutual of Omaha

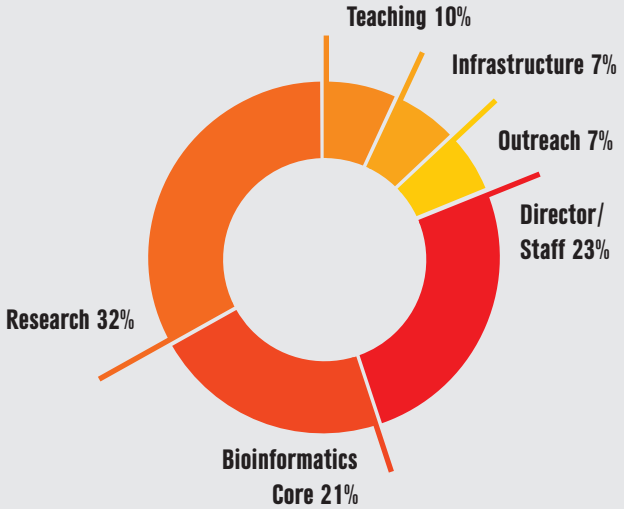
A data analytics competition open to undergraduate and graduate students in which teams work to find and share meaning from a large, rich and complex dataset. After analyzing data provided by an industry sponsor teams will present to a panel of judges to compete for awards.

International Plant Phenotyping Symposium: Nanjing, China, October 2019

IPPN is an association representing the major plant phenotyping centers that aims to provide all relevant information about plant phenotyping. The goal is to increase the visibility and impact of plant phenotyping and enable cooperation by fostering communication between stakeholders in academia, industry, government, and the general public. Through workshops and symposia, IPPN seeks to establish different working groups and distribute all relevant information about plant phenotyping in a web-based platform.

Financials

2016-2018 Budget



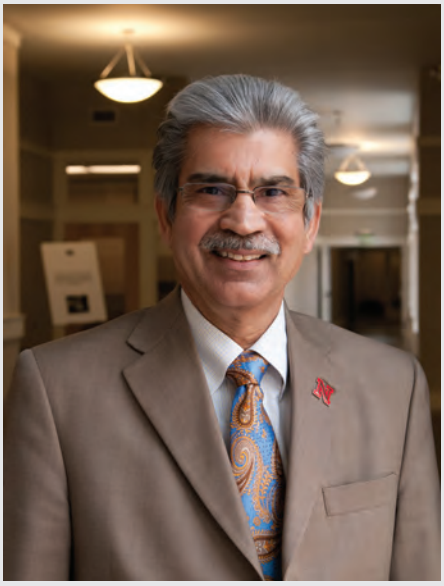
Members of the Initiative receive funding from multiple agencies:

National Science Foundation

National Institutes of Health

National Institute of Justice

United States Department of Agriculture



In Remembrance

Prem S. Paul, Vice Chancellor for Research and Economic Development

2001-2016

Prem S. Paul Research Center at Whittier School