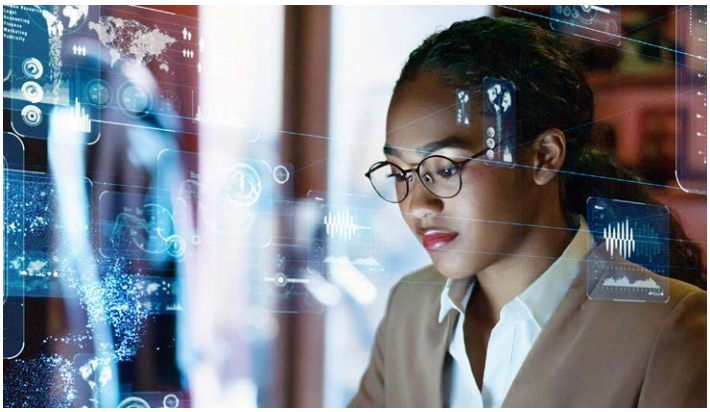
DATA INSTITUTE FOR SOCIETAL CHALLENGES

STRATEGIC PLAN

DATA INSTITUTE FOR SOCIETAL CHALLENGES

WHERE WE'RE GOING TO HAVE AN IMPACT

Data science is becoming increasingly critical to current and future discovery and innovation in the state of Oklahoma, the nation, and the world. The University of Oklahoma (OU) is redefining the landscape as a leading center of excellence in data science research and data-driven solutions. With the introduction of the Data Institute for Societal Challenges (DISC), OU is swiftly advancing the forefront of discovery through its investment in highly skilled researchers, top-tier research facilities, and partnerships that bridge the academic, private, industrial, and governmental sectors. DISC is setting a new benchmark for cutting-edge advances in artificial intelligence, machine learning, and real-world applications driven by advancements in data-enabled research. OU's extensive research investment in these technologies will profoundly impact society, from breakthroughs in the development of robust and predictive software and guidance systems used by the US Air Force, Army, and Department of Homeland Security, to advances in precision medicine that aid in the early detection and more effective treatment of disease, to the development of more accurate, timely, physics-informed weather and severe storm predictions and forecasts, all of which protect millions of lives. The development of ecologically sustainable communities and energy grids, as well as transformed modern supply chains around the world, are not just goals, they are achievable through the data science research endeavors at OU.



The DISC team is focused, driven, and fully committed to tackling the greatest data science challenges facing society today and tomorrow to develop real-world solutions and innovation at the local and global scale. Through the development and growth of convergent research teams, DISC will achieve these goals and lead the way in foundational data science and data-enabled research for aerospace, defense, and global security; community and societal transformation; the future of health; and the environment, energy, and sustainability. Societal challenges recognized, solutions realized – DISC is defining what it means to be a leader in data science research.

Human-Guided Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning (ML) are unlocking the next generation of advances in science, engineering, and other disciplines. AI and ML are currently used in a variety of capacities, such as developing pricing models for utilities and assisting with drug and protein discovery. However, AI and ML systems function in ways that are not always well understood and are still in their infancy.

The goal of developing robust, trustable, explainable, and fair AI and ML is to help users understand how these systems produce results, remove biases in how these systems work, and promote the further use and adoption of AI and ML. Developing interactive, human-guided techniques that harness user expertise and knowledge has the potential to improve the robustness and performance of pure automated AI/ML techniques and to increase understandability and trust in the results.

AI and ML will have a lasting impact on the community, the nation, and the world. For example, the near-term impacts include the development of the next generation of AI and ML systems to help public health officials respond to infectious diseases, predict the development and trajectories of large-scale weather events, and generate patient-specific treatment strategies. AI and ML have the potential to unlock new insights for low-carbon power grids and carbon-neutral energy production.

OU is currently using and developing innovative AI and ML convergent research that brings together expertise from science, engineering, and social science, as well as computer and data science. Specifically, OU is home to one of five NSF Artificial Intelligence Institutes that will create trustworthy AI methods for environmental scientists while revolutionizing our understanding of atmospheric phenomena. DISC is leading an NSF Planning Grant to create a roadmap for ensuring sustainable agricultural production and communities using AI and ML. DISC will build on OU's strength in integrating AI/ML specialists with social scientists, cognitive psychologists, political scientists, biologists, and engineers to create cross-disciplinary AI/ML solutions for advancing theories to solve societal challenges.

Human-Computer Teaming

Human-computer teaming, a critical problem space for data-enabled research, is the efficient and effective integration of humans and complex machines. Effectively blending human and machine capabilities while accounting for the unique strengths and limitations of both will enable us to address complex problems, such as introducing autonomous vehicles to roadways, disaster recovery, and medical diagnostics.

Over the last 25 years, discoveries in cognitive neuroscience and technological advancements in machine learning have led to new insights into the underlying capacities needed to support effective human-computer teams and overcome the limited contextual knowledge, cognitive inflexibility, and opaqueness of AI and ML. Transforming intelligent machines from tools to teammates requires cognitive and computational models of beliefs, desires, intentionality, and capabilities. Our approach draws on the expertise of cognitive psychologists, device designers, human factors

engineers, decision-making and risk-perception researchers, user experience researchers, and computer scientists. Each supplies unique insights into how humans work in team science and process design.

Many aspects of society can benefit from improvements in human-computer teaming. OU researchers are well-positioned to address these challenges, given the existing strengths and collaborations of AI and ML specialists and social scientists, cognitive and social psychologists, computer scientists, human factors engineers, and medical researchers, scientists, and engineers.

Predictive Analytics

Predictive analytics, the practice of analyzing and mining data and historical trends to make a prediction or find a solution, is empowering research, policies, and decisions that affect our daily lives. Predictive analytics is needed to solve some of the world's most pressing problems.

OU researchers have expertise in creating tools and systems capable of extracting, assimilating, and analyzing data for accurate, timely, reliable forecasts and predictions with quantifiable uncertainty. Predictive analytics are already impacting our daily lives by transforming drug discovery, vaccine production, and enabling effective, personalized treatments and new pathways for the future of health. Futhermore, predictive analytics have led to earlier and more precise forecasts for the impact of various events. However, research is needed to identify and correct for some potential pitfalls of predictive analytics. Our goal is to develop analytics in such a way that we can be constantly correcting for unintended consequences or adverse implications.

OU centers and labs are conducting research at the forefront of predictive analytics, including industrial, health, atmospheric science, and business applications. One such center is the Energy Institute in the Price College of Business, which uses predictive analytics to assess the impact of risk on energy markets. Additionally, OU has multidisciplinary research teams developing predictive analytics to detect and deter the spread of medical misinformation. These teams bring science-based and social principles together with statistical and computational theories to develop new impactful and robust predictive analytics for many domains.

Collaborative, Data-Driven, Discovery, and Decision-Making Environment; Visual Analytics

The data revolution has led to a rapid increase in the rate at which systems generate and store data. Computers are better equipped and designed to process, store, and utilize large volumes of data than humans are. Combining human expertise with computational methods through interactive environments and visual analytics systems improves data-driven decision-making.

Recent advances in AI and deep learning have made it feasible to combine highly accurate and efficient ML outputs with human expertise to generate actionable insights for decision-making in domains such as cyber and aerospace security, disaster response, agriculture and community sustainability, and medical preparedness. Further, developing novel visual analytics systems that combine state-of-the-art AI and interactive techniques will be foundational to providing near

real-time decision-making environments in which users can rapidly identify complex patterns and actionable insights from massive amounts of data.

The design, development, and deployment of human-computer decision-support systems is an enabling technology for discovering new relationships and is relevant to all of OU's strategic pillars. Innovative human-computer collaborative environments can expedite and improve situational awareness and decision-making related to public health crises, natural disasters, global security, environmental sustainability, and community outreach. One such project led by OU researchers has been the development of machine learning models to help doctors predict preeclampsia in pregnant women.

OU is well-positioned to provide innovative solutions for data-driven decision-making and visual analytics by leveraging the skills and expertise of leading interdisciplinary researchers in centers such as DISC, the Cognitive Science Research Center, and the Center for Cyber-Physical-Social Systems.

Scalable, High-Performance Software and Hardware Architectures

Cutting-edge AI and ML algorithms are computationally intensive and must process large quantities of data to perform well. The slow training and performance of AI and ML algorithms are attributable to large volumes of data necessary for learning and their increasing computational complexity. This challenge limits their wider use in real-time applications (e.g., self-driving cars). Interdisciplinary teams researching solutions to global grand challenges need scalable and elastic solutions powered by emerging computing architectures, cloud-based storage, and the processing of globally distributed data.

Neuromorphic computing, probabilistic computing, and quantum computing, all have the potential to transform our ability to create real-time, trustable AI and ML solutions. These new hardware architectures also require updated software architectures and pipelines for reliable, efficient execution that can scale to the ever-growing sea of data generated by evolving sensing technologies and platforms. The development of these new hardware and software architectures enables advances in AI and ML research. Specifically, these technologies would enable AI and ML systems to be used in situations where scalable, secure, and real-time processing is needed, such as pandemic response, object detection for cyber and aerospace defense, and route efficiency optimization.

At OU, we have research teams developing and applying these new approaches to power data-enabled science as they work to solve problems such as early detection and response to emerging infectious diseases; sub-surface carbon sequestration to create net-zero carbon energy and sustainable environmental solutions; improved maintenance and life-extension of critical defense aircrafts; improved medical treatments and strategies to reduce health disparity; digital preservation of cultural artifacts and understanding of ancient peoples and societies; and social justice and reduced disparity among communities. The ongoing, synergistic research at OU AI and ML in seeks to solve today's challenges using tomorrow's technologies.

DATA INSTITUTE FOR SOCIETAL CHALLENGES

HOW WE'RE GOING TO SUCCEED

MISSION

Empower transdisciplinary research and collaboration to drive convergent solutions to societal challenges in Oklahoma, the nation, and the world through data science research, tools, and capabilities.

VISION

OU is a nationally recognized leader for data science research and data-driven solutions to societal challenges.

STRATEGY 1

Develop, sustain, and grow a robust and transdisciplinary network of diverse OU researchers while enhancing research accessibility, quality, diversity, and competitiveness.

TACTIC 1.1 Develop OU data science communities of practice. (Q1, 2021)

TACTIC 1.2 Create an OU DISC membership model and increase the number of members in the DISC network. (Q1 2021)

TACTIC 1.3 Develop and publish a newsletter containing upcoming funding information, DISC affiliate profiles, and publication announcements. (Start Q1 FY2021)

TACTIC 1.4 Develop talent recruitment and retention pipeline for faculty, staff, postdocs, and students. (Q2 FY2021)

TACTIC 1.5 Provide support for developing data science and data enabled research proposals. (START Q2 FY 2021)

STRATEGY 2

Establish relationships and partnerships with external researchers, scholars, and industry to address societal challenges using data science tools.

TACTIC 2.1 Develop a partnership plan to pursue external funding and collaborative research. (2021)

TACTIC 2.2 Establish a learning community and network with other similarly situated data science institutes at universities. (2021)

TACTIC 2.3 Create a guest speaker program. (2021)

TACTIC 2.4 Develop and submit a proposal for a Dream Course with external speakers on Data Science and Societal Transformation for Social Good. (2022)

TACTIC 2.5 Establish a process to support OU faculty grant proposal submissions with external partners as lead, co-lead, or subcontractors. (Start in 2021)

TACTIC 2.6 Create a program of events to engage public state agency leadership. (2022)

TACTIC 2.7 Establish a community and corporate affiliates program. (2022)

TACTIC 2.8 Establish named student data science/data science scholarships funded by industry leaders and begin recruiting student DISC fellows. (2023)

STRATEGY 3

Build a growing and sustainable financial foundation that will support the institute's operations and increase the amount and quality of data-enabled research at OU.

TACTIC 3.1 Develop and implement a financial plan to ensure DISC sustainability and growth. (Q1 2021)

TACTIC 3.2 Create a plan to lead federal funding applications in data science or data-enabled research per FY. (Q2 2021)

TACTIC 3.3 Incubate federal funding applications in data science or data-enabled research per FY. (Q3 2021)

TACTIC 3.4 Develop a seed funding program to grow data science research and data-enabled research initiatives. (Q3 2021)

TACTIC 3.5 Create a corporate affiliates/partnership program. (Q4 2021)

STRATEGY 4

Partner with stakeholders across OU to identify, build, and provide the necessary data science capabilities and infrastructure to effectively lead and support data science research.

TACTIC 4.1 Create a plan to identify relevant OU stakeholders with critical data science capabilities and infrastructure needs. (Q1 2021)

TACTIC 4.2 Develop a marketing and communication initiative across all three campuses that highlights DISC capabilities. (Q2 2021)

TACTIC 4.3 Create a data science capabilities support ecosystem across campus. (Q2 2021)

TACTIC 4.4 Develop and grow OU stakeholder training in data analytics and data-enabled research techniques. (Q1 2022)

STRATEGY 5

Be nationally recognized as a leader in data science and data-enabled science by accelerating and advancing emerging research in data science, engineering, science, and creative activities driven by real-world applications.

TACTIC 5.1 Develop and deploy an outreach and communication plan for DISC. (Q1 2021)

TACTIC 5.2 Facilitate data-enabled research proposal team submissions covering important problems in each of the Lead On Research Strategic Plan verticals. (Q1 2021)

TACTIC 5.3 Create a public events program. (Starting in Q2 2021)

TACTIC 5.4 Establish and track metrics for OU recognition. (Q2 2021)

TACTIC 5.5 Increase DISC student membership through involvement in data-enabled or data science research projects by 5% every year. (Q2 2021)

TACTIC 5.6 Create an early career competitive travel grant program. (Q3 2021)

TACTIC 5.7 Increase DISC member external research presence by 5% per year. (Q3 2021)

TACTIC 5.8 Grow OU data science and data-enabled faculty by three faculty per FY. (Q4 2021)

TACTIC 5.9 Create DISC undergraduate data science research program in collaboration with programs across campus. (Q1 2022)

TACTIC 5.10 Increase OU recognition by 10% per 18 months starting in 2022.

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The UNIVERSITY *of* OKLAHOMA