



SPRING 2024

Artificial Intelligence at Clemson University

A high-level overview of the centers, research and people engaged in artificial intelligence (AI) related activities.

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01 Introduction

Clemson scientists are using AI and Machine Learning to identify optimal materials for manufacturing batteries, to advance personalized medicine and to conserve water in farming. They are utilizing AI to identify advanced chemicals for pharmaceuticals and other products, to train K-12 students and teachers, and even to better understand Shakespeare's Hamlet. These are a few examples of the diverse range of AI applications put into practice by Clemson.

Importantly, Clemson also is preparing a skilled workforce to handle the evolving integration of AI into our lives, not just at collegiate level, but at the elementary and high school levels, as well. Clemson researchers are developing K-12 curriculum, for example, to teach students about AI, its applications and the potential cybersecurity threats. AI is a growing field of which Clemson has established strong expertise.

Topics (non-exhaustive):

- Precision Medicine/Public Health
- Pharmaceuticals
- Advanced Chemicals
- Energy Storage/Battery Technology
- Cybersecurity
- Graphic Design
- Precision Farming
- Crop Improvement
- K-12 Education
- AI Ethics and Privacy
- Robotics and Manufacturing
- Connected Mobility
- Cybersecurity
- Environmental Stewardship
- Childhood Development
- Disaster Response
- Workforce Development

02 Centers and Institutes



Clemson Artificial Intelligence Research Institute for Science and Engineering (AIRISE)

Clemson researchers have deployed artificial intelligence to protect self-driving vehicles from cyberattacks, inspect vehicles for defects as they travel an assembly line, safeguard reputations on social media, detect cyberbullying, and diagnose Alzheimer's disease earlier than currently possible. With over 100 affiliate faculty from over 30

disciplines, AIRISE serves as the umbrella for pioneering AI research, education, and STEM workforce development at Clemson University.

Clemson-MUSC AI Hub

The Clemson-MUSC AI Hub fosters cross-institutional research at the intersection of AI and medical research, with projects ranging from predicting the effectiveness of cancer treatment to the examining the effects of alcohol on neural behavior.



Watt AI Program

The Watt AI program helps faculty, staff and students across disciplines incorporate artificial intelligence and machine learning technologies into their research. The program provides the opportunity for students to learn about AI in the classroom as well as get hands-on experience using AI technology to solve real-world problems.

02 Centers and Institutes (continued)



Media Forensics Hub

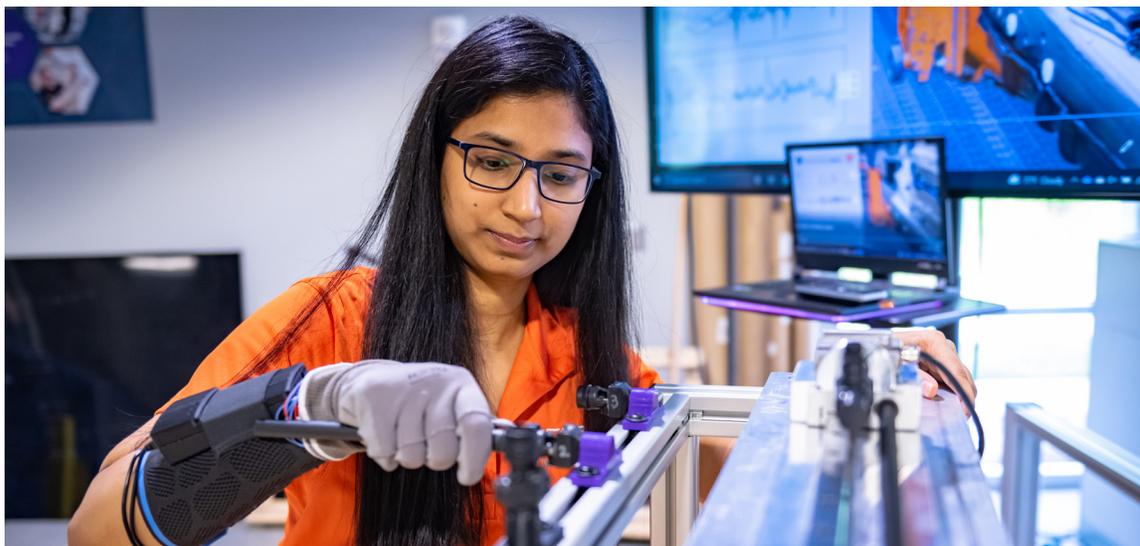
The Media Forensics Hub is an interdisciplinary team of researchers working to study and combat online deception with the goal of building society's resilience to the dangers it poses. The Hub accomplishes this by spanning multiple disciplines and approaches, from history and case studies, to AI and machine learning, to experiments in the lab and the field.

School of Computing

Faculty in the School of Computing are heavily involved in numerous areas of research into AI and Machine Learning and their applications in manufacturing, healthcare, emergency response, quantum computing, agriculture, materials and much more. Additionally, the School offers individual AI-related courses for students, as well as a graduate degree in Biomedical Data Science and Informatics, which applies techniques like AI to applications in health care.



03 Research Topics



Advanced Health Care

Clemson leads a statewide initiative to develop new medical devices powered by AI to improve healthcare diagnostics, treatment and rehabilitation. Working closely with technical colleges, undergraduate institutions and the private sector, the project emphasizes workforce development and translational research that will help patients across the state. The project – Artificial Intelligence-Enabled Devices for the Advancement of Personalized and Transformative Health Care in South Carolina or ADAPT-SC – is funded by a \$20 million grant from the National Science Foundation.

Emergency Management Response

Four Clemson University researchers helped develop a Flood Evacuation Tool that uses AI to help forecast floods, identify at-risk roads and verify safe evacuation routes. The tool partners artificial intelligence (AI) with human knowledge. Researchers are using this human-AI teaming (HAT) partnership to create an intelligent model for addressing flood evacuation decisions in isolated South Carolina rural coastal communities. Current flood evacuation models include Geographic Information System (GIS) and infrastructure planning approaches, which do not use artificial intelligence.

AI Workforce Development

The National Science Foundation tasked Clemson through a new \$3 million investment to develop new training initiatives and courses to prepare students for work in AI-integrated composite design. The project, “Harnessing AI for Inverse Design Training in Advanced and Sustainable Composites (IDeAS Composites),” brings together an interdisciplinary group of automotive, mechanical, materials science and computer science engineers with mathematics and educational psychologists.

03 Research Topics (continued)

Professional Development for Educators

Clemson developed a platform that uses AI to improve professional development for South Carolina teachers. To date, 225 STEM teachers from 50 schools across South Carolina have been engaged, with the results showing increased teacher effectiveness and improved student performance.

Human-AI Teaming

Clemson is working to make Artificial Intelligence (AI) a better teammate. AI is increasingly used to perform certain tasks alongside humans. Current task-oriented AI systems, however, lack the ability to learn, think and act in shared manners toward a common goal, a process called team cognition. Clemson is working to develop AI systems that act as good teammates with humans, making AI not only more effective, but more accepted and thus utilized.

Manufacturing Operational Improvements

Clemson automotive engineers are using Machine Learning to not only improve prescriptive manufacturing equipment maintenance, but also to pinpoint equipment failure modes through real-time data collection from in-line equipment. AI also is helping to quickly pinpoint manufacturing defects on products still on the assembly line, saving manufacturers time and cost.

Automotive Systems

Clemson researchers are using deep learning to model engine, emission treatment systems and batteries, as well as developing AI algorithms for continual vehicle energy efficiency improvements and for electric and hybrid vehicle battery management.



Worker Safety

A new hearing-protection technology under development at Clemson utilizes artificial intelligence to augment the audibility of safety-critical sounds while effectively blocking loud, unwanted noises that are part of the job. This new noise-canceling technology, when successfully developed, will have a great potential to enhance the safety of work zones.

Nuclear Waste Storage

Clemson researchers are using AI to sift through massive amounts of data to aid in the design and performance evaluation of a repository for nuclear waste. AI helps to evaluate adsorption properties of radionuclides to design strategies to prevent their release into the environment.

03 Research Topics (continued)

Water Quality and Treatment

Similar to the nuclear repository project, researchers are using AI to examine water quality and optimize operations of wastewater treatment systems, working directly with utilities in South Carolina.



Work/Life Skills Support

This project utilizes AI to design and assess the potential of assistive technology to support people with mild cognitive impairment (MCI) and mild dementia in the workplace. Another project supports the development of autistic students' routine management skills in higher education, and another identifies challenges and opportunities with Generative AI use for older adults and people with dementia.

Airline Safety/ Worker Training

The National Science Foundation invested \$2 million into a program called Future of Work at the Human-Technology Frontier: Core Research. The team plans to develop artificial intelligence that

would combine with "extended reality" technologies to help technicians ensure planes are safe to fly.

Advanced Materials

Machine learning and artificial intelligence has wide usage in Clemson research on advanced materials. For example, AI can assist in the design and manufacturing of sensors, membrane devices, and smart bio-components, or in advanced processing and manufacturing of ceramic devices for energy conversion and sensors for clinical surgeries.

Connected Mobility/Autonomous Vehicles

Clemson researchers utilize AI to improve controls for autonomous vehicles and for the development of intelligent, secure infrastructure for transportation systems that support the efficient movement of freight and safe transportation for pedestrians, cyclists and automotive vehicles. Researchers are also using AI for detecting cyberattacks against vehicles.

Precision Medicine

A Clemson research is developing interpretable statistical and deep learning methods that integrate imaging genomics analysis into precision medicine. For example, one research project involves examining visual images of human brains and looking for anomalies that could correlate to Alzheimer's disease, the sixth-leading cause of death among adults in the U.S.

04 Faculty Utilizing AI

- **Amy Apon**, professor, School of Computing
- **Beshah Ayalew**, professor, automotive engineering
- **Golnaz Arastoopour Irgens**, assistant professor, education and human development
- **Ahmed Ali**, assistant professor, animal and veterinary science
- **Nicole Bannister**, associate professor, mathematics education
- **Long Cheng**, assistant professor, School of Computing
- **Mashrur “Ronnie” Chowdhury**, chair, transportation
- **Brian Dean**, director, School of Computing
- **Emma Dixon**, assistant professor, School of Computing
- **Andy Duan**, professor, School of Computing
- **Zhana Duren**, assistant professor, genetics and biochemistry
- **Chao Fan**, assistant professor, civil engineering
- **Saeed Farahani**, assistant professor, automotive engineering
- **Alex Feltus**, professor, genetics and biochemistry
- **Steve Foulger**, endowed chair, materials science and engineering
- **Bruce Gao**, endowed chair, biofabrication engineering
- **Carlos Garcia**, professor, chemistry
- **Rong Ge**, professor, School of Computing
- **Michael Giebelhausen**, associate professor, marketing
- **Jordon Gilmore**, associate professor, bioengineering
- **Ron Gimbel**, director, Clemson Rural Health
- **Anand Gramopadhye**, dean, College of Engineering, Computing and Applied Sciences
- **Reed Gurchiek**, assistant professor, bioengineering
- **Dani Herro**, professor, education and human development
- **Hao Hu**, assistant professor, mathematical and statistical sciences
- **Yunyi Jia**, associate professor, automotive engineering
- **Mark Johnson**, endowed chair, materials science and engineering
- **Tanju Karanfil**, senior vice president for research, scholarship and creative endeavors, and professor, environmental engineering and earth sciences
- **David Karig**, associate professor, bioengineering

04 Faculty Utilizing AI (continued)

- **Atul Kelkar**, chair, mechanical engineering
- **Amin Khademi**, associate professor, industrial engineering
- **Venkat Krovi**, endowed chair, automotive engineering
- **Ethan Kung**, associate professor, mechanical engineering
- **Tuyen Le**, assistant professor, civil engineering
- **Bing Li**, assistant professor, automotive engineering
- **Dan Li**, assistant professor, industrial engineering
- **Nianyi Li**, assistant professor, School of Computing
- **Xinyi Li**, assistant professor, mathematical and statistical sciences
- **Kai Liu**, assistant professor, School of Computing
- **Feng Luo**, professor, School of Computing
- **Qi Luo**, assistant professor, industrial engineering
- **Kapil Chalil Madathil**, professor, industrial engineering
- **Joe Maja**, assistant professor, agricultural sciences
- **Jeff Marshall**, professor, education
- **Christopher McMahan**, co-lead, Clemson-MUSC AI Hub
- **Nathan McNeese**, endowed associate professor, human-centered computing
- **Laine Mears**, chair, automotive engineering
- **Larry Murdoch**, professor, environmental engineering and earth sciences
- **Chelsea Murdock**, director, Clemson Writing Lab
- **Oliver Myers**, associate dean, mechanical engineering
- **M.Z. Naser**, assistant professor, civil engineering
- **José Payero**, assistant professor, agricultural sciences
- **Fei Peng**, associate professor, materials science and engineering
- **Brian Powell**, professor, nuclear environmental engineering and science
- **Apparao Rao**, endowed professor, physics and astronomy
- **Trevor Rife**, assistant professor, plant breeding and genetics
- **Enrique Saez**, associate professor, mechanical engineering
- **Vidya Samadi**, water systems modeler, agricultural sciences
- **Mitch Shue**, professor of practice, School of Computing

04 Faculty Utilizing AI (continued)

- **Joseph Singapogu**, assistant professor, bioengineering
- **Drew Sisk**, assistant professor, graphic design
- **Phanindra Tallapragada**, associate professor, mechanical engineering
- **Sumanta Tewari**, professor, physics and astronomy
- **Joshua Tong**, professor, materials science and engineering
- **Cameron Turner**, associate professor, mechanical engineering
- **Umesh Vaidya**, professor, mechanical engineering
- **Javad Velni**, professor, mechanical engineering
- **LJ Wang**, associate professor, genetics and biochemistry
- **Yue Wang**, professor, mechanical engineering
- **Patrick Warren**, associate professor, economics
- **Huijuan Zhao**, associate professor, mechanical engineering