

CENTER FOR APPLIED ARTIFICIAL INTELLIGENCE

Executive Report
2026 YTD



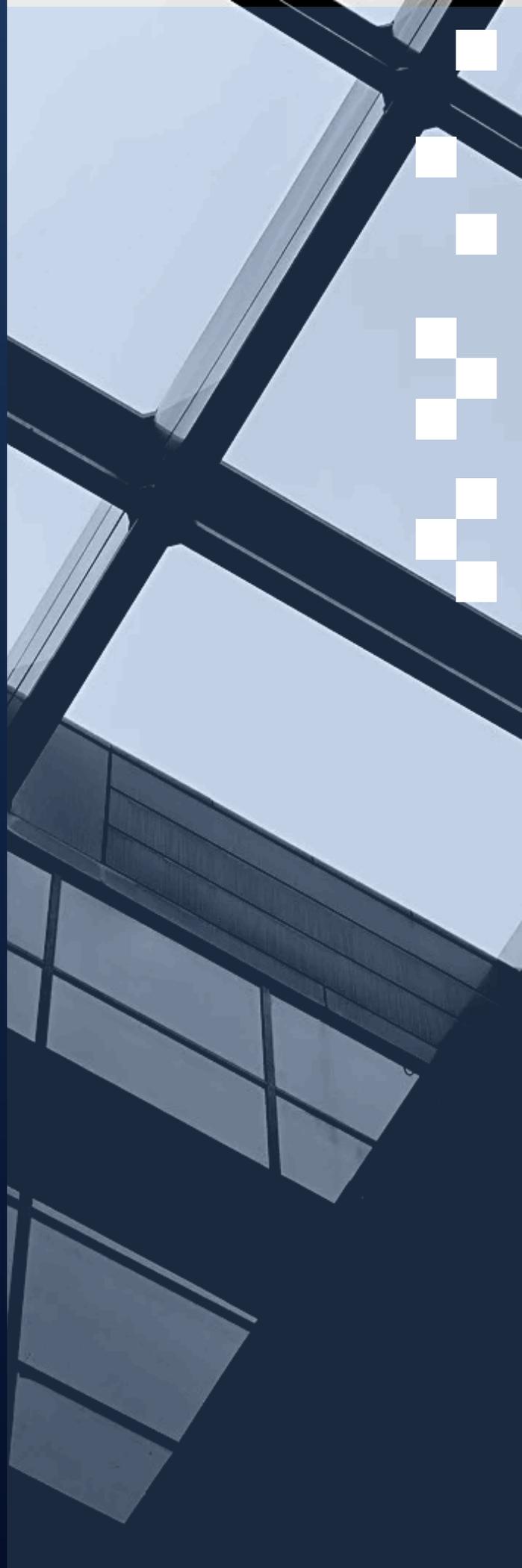
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Note from the Director

Dear Colleagues,

As we witness remarkable progress in artificial intelligence, including advancements in reasoning and generative models, we find ourselves at a pivotal moment for healthcare and the life sciences. These advances offer extraordinary potential to bridge disciplines, accelerate the research-to-practice pipeline, and solve problems at scales previously unimaginable. However, they also demand something of us: a commitment to building AI that is not only powerful, but accurate, explainable, reproducible, and grounded in golden standards for validation. At the University of Kentucky's Center for Applied AI (CAAI), we believe responsible innovation is the foundation for AI that earns trust and delivers lasting impact.



Kentucky, like many states, faces a persistent challenge between scientific discovery and improved patient outcomes. Our mission is to help collapse that timeline by building AI infrastructure designed specifically for translational science, moving insights from laboratory to clinic to community. We're guided by principles that prioritize generalizable solutions, cross-disciplinary collaboration, and the speed required to make research matter in people's lives.

What distinguishes our work is our collaborative structure. Our projects bring together clinicians, bioinformaticians, data scientists, and domain experts as co-investigators from the outset. This team science approach ensures that our AI solutions address genuine care delivery challenges, and reflects the expertise of the people who will ultimately use it.

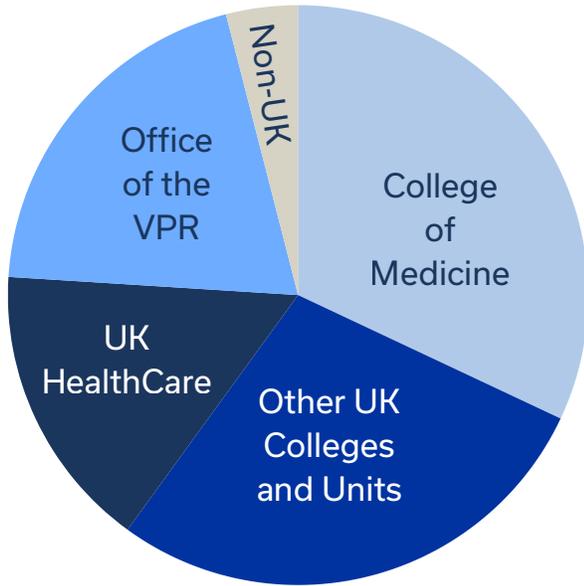
We've also invested in infrastructure that accelerates the research cycle itself. Our secure, on-campus platforms enable researchers to access diverse data types (medical imaging, electronic health records, genomic sequences, patient surveys) within an environment designed for both innovation and compliance. By reducing friction between data access, model development, and clinical validation, we're compressing timelines that traditionally span years into months, all while maintaining the data integrity and privacy that sensitive healthcare applications demand.

As we continue this work, I'm reminded that AI's ultimate value in healthcare will be measured not by technical sophistication alone, but by how effectively it serves patients, supports clinicians, and strengthens communities. I invite you to join us in building an AI ecosystem that honors these values. One that is rigorous and responsive, innovative and accountable, and deeply rooted in our shared mission of translating discovery into health.

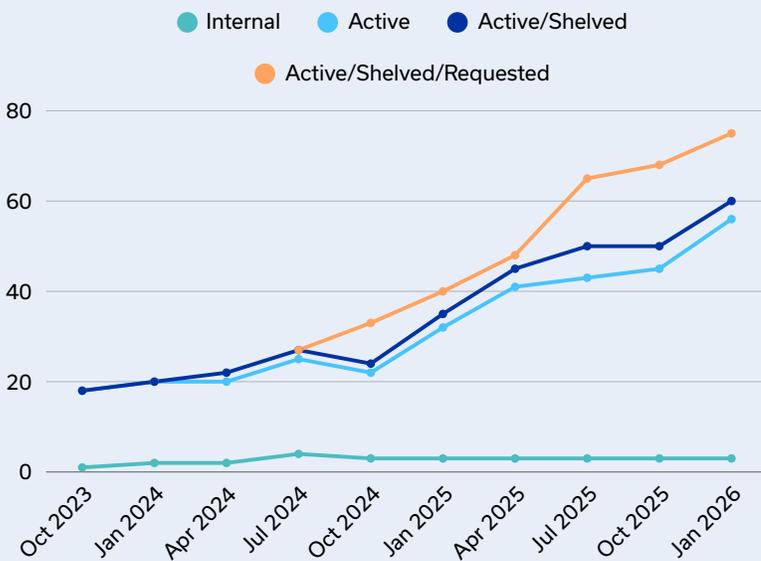
Sincerely,

V. K. Cody Bumgardner

Highlights FY26



Engagement by Administrative Group



Project Growth 2023-Present



Growth and Demand

Since its inception, CAAI has experienced rapid and sustained growth, driven by increasing demand for applied artificial intelligence and the Center's ability to consistently translate ideas into measurable impact. Active projects expanded from fewer than 20 in 2023 to more than 70 in 2025, reflecting growing engagement from partners across campus, the university's healthcare enterprise, and external organizations. This growth is the result of a deliberately collaborative operating model that embeds technical expertise alongside domain teams, lowers barriers to entry, and supports projects from early concept through deployment. Combined with strong data governance, privacy- and security-first practices, and access to secure, scalable compute resources, CAAI has established a trusted, repeatable framework for advancing AI-driven innovation across a wide range of disciplines.

By the Numbers:

Since 2023, CAAI has been the lead contributor on over **115** AI projects, has completed **42** projects, and maintains a network of **43** institutional partners and more than **120** individual collaborators.



\$80M

Grant awards with CAAI participation



56%

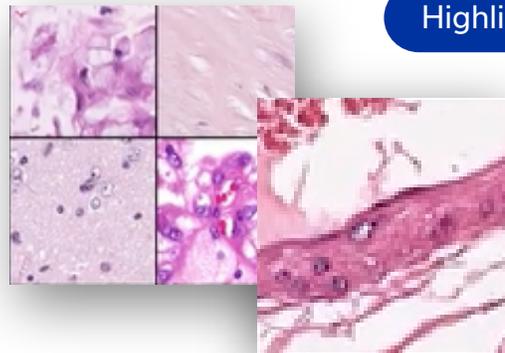
Staff effort funded through external mechanisms



115

AI Projects with CAAI as Lead Contributor

Highlights



Appalachian Tr(ai) Team Spotlight: NeurIPS 2025!

In partnership with the University of Louisville, Emory University, Karabuk University and West Virginia University, CAAI participated in the Self-supervised Learning for Cancer Pathology Foundation Models NeurIPS 2025 Challenge, which aims to advance the development of the next generation of pathology foundation models.

Our team developed a novel methodology to improve model training by filtering out low-quality or non-informative image regions and ensuring better representation of diverse tissue and disease patterns. We then applied a "divide-and-conquer" training strategy in which multiple expert models were trained on different image groups and then integrated into a single unified model. Our innovative approach led to an invitation to present our work, highlighting the Center's leadership in advancing robust and generalizable AI methods for computational pathology.



Center Overview

Empowering our communities to solve problems using AI.

The Center for Applied Artificial Intelligence (CAAI) is an innovative engine that accelerates the responsible use of AI across academia, healthcare, government, and the technology sector. We convene thought leaders and domain experts to move AI from concept to impact, bridging institutional silos and aligning innovation with real-world needs.

Operating like a problem-solving think-tank, CAAI is an agile, flat, and lean organization designed to fuel entrepreneurship and rapid experimentation. Our team moves quickly to transform ideas into tested solutions without requiring collaborators to have technical backgrounds or make costly investments. We follow three core tenets that guide how we work and how we partner: **Empowering. Exploring. Doing.**

These tenets help us empower faculty, staff, researchers, clinicians, and students by removing common barriers to AI adoption, including technical expertise and secure compute resources.

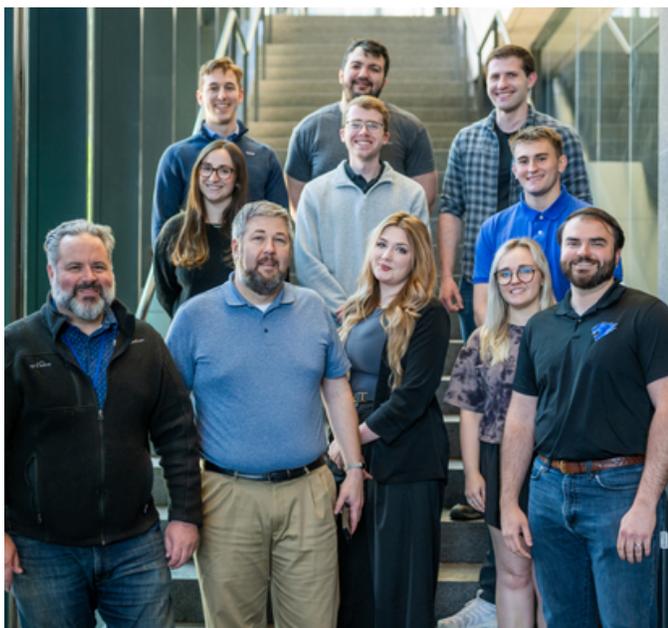
Our staff expertise spans software development, data science, project management, and advisory roles to provide hands-on support while maintaining secure, private AI infrastructure and interoperable toolsets that dramatically reduce time to impact.

CAAI provides the diligence of academia with the execution of industry. Through applied projects, mentorship, and real-world problem solving, we develop the next generation of AI practitioners while delivering deployable solutions.

Our work includes enabling county extension agents statewide to make research accessible through natural-language querying, preserving Kentucky's history by transcribing more than 19,000 audio and video recordings, and deploying virtual assistants to guide patients through pre-treatment care—pairing technical excellence with **measurable community impact.**

Advancing the health, wellness, & economic future of Kentucky.

The University of Kentucky's mission and vision is to advance Kentucky in every way that improves the health and quality of life for the people of the Commonwealth. Ensuring a healthy state is paramount to that goal and encompasses not only physical health—the prevention and treatment of disease—but also the well-being and economic vitality of a sustainable, skilled workforce. A healthy Kentucky also contributes to the economic growth of the country and to the advancement of research globally. CAAI believes that AI holds immense potential in the attainment of these goals.



CAAI supports UK's mission by applying AI to improve health outcomes, advance research, and develop the future workforce. Team members guide collaborators through common AI technical barriers to rapidly turn ideas into prototypes. Functioning as a technology bridge between science and engineering, CAAI develops pipelines for the repeatable and verifiable use of AI across research domains. To expand AI use cases, CAAI develops self-service tools, templated modules, and code repositories. Educational assets, including websites, online forums, videos, and workshops provide continuous learning.

Our Approach

Turning ideas into solutions that push the boundaries of discovery and impact.

CAAI accelerates the responsible use of artificial intelligence by transforming ambitious ideas into scalable, real-world solutions. The Center focuses on developing innovative AI capabilities while also confronting the structural barriers that often slow progress, such as fragmented data, brittle models, and disconnected analytical workflows. Its work prioritizes the creation of adaptable, reusable tools designed to extend beyond a single project, dataset, or discipline. Central to this mission is the formation of cross-disciplinary teams that unite AI expertise with deep domain knowledge, ensuring solutions are both technically robust and operationally meaningful. By emphasizing scalability, reproducibility, and clear pathways to translation, CAAI strengthens the research ecosystem and creates the conditions for sustained, collaborative impact.

Speed: From Idea → Prototype → Impact

Accelerate early findings, strengthen grant applications, & provide feasibility data

Expertise: Subject Matter Experts & Leaders in AI

Guidance across model design, validation, & evaluation

Infrastructure: Built for Secure, Scalable AI

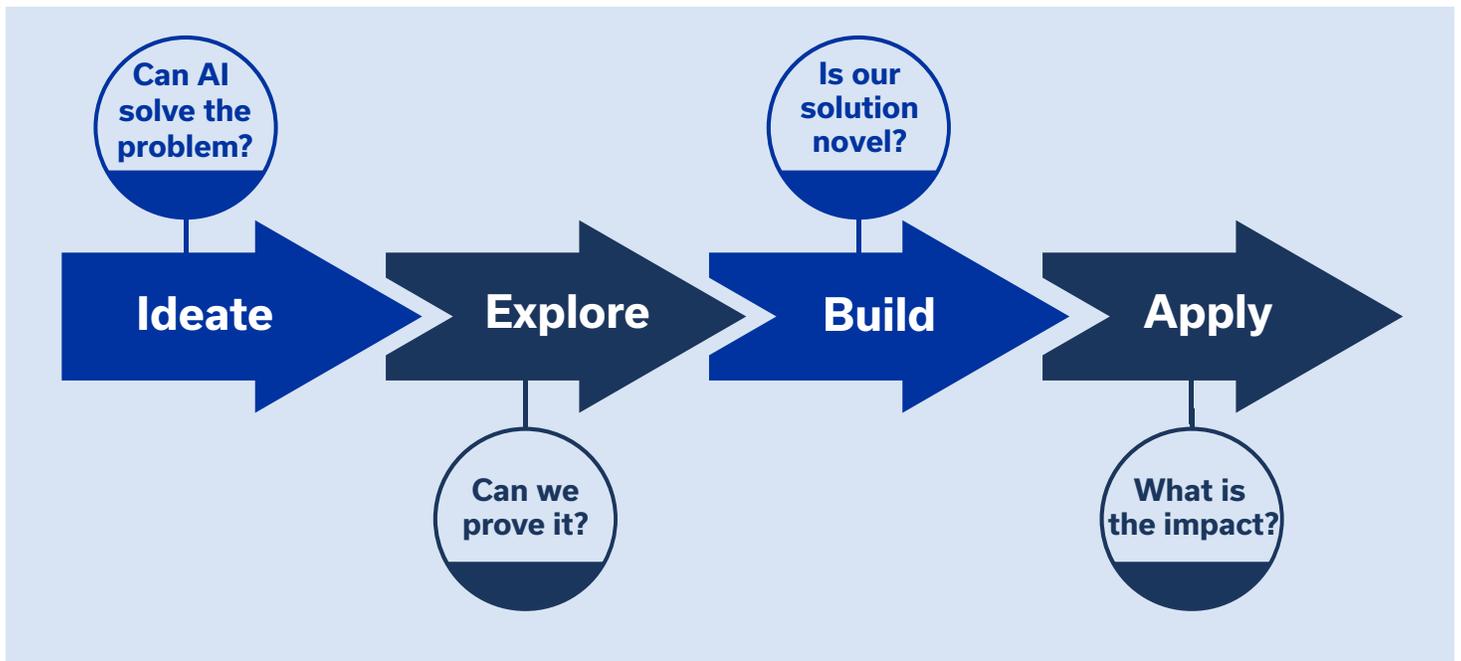
Secure computing, reproducible pipelines, dataset standards, & foundational AI models

Workforce Development: Building Translational AI Talent

Training & mentorship pipeline from students to interns to staff

Innovation in Practice

CAAI partners with investigators and teams throughout the full research and innovation lifecycle, serving as a connective bridge between domain science and advanced engineering. Early-stage ideas are supported through collaborative exploration and rapid prototyping, allowing teams to move quickly from concept to proof-of-concept. Promising efforts are then strengthened into fundable pilots, and mature projects are advanced into research-ready AI applications that align with the university's mission and goals.



Throughout this process, CAAI team members work closely with collaborators to navigate common technical barriers in data access, modeling, and evaluation. By developing shared pipelines, reusable modules, and verifiable workflows, the Center enables repeatable and trustworthy use of AI across research domains. To further expand access and scale impact, CAAI invests in generalizable tools, templated resources, and shared code repositories, complemented by educational offerings such as workshops, online materials, and community forums that support continuous learning.

As demand for AI continues to grow across colleges, centers, disciplines, and external partnerships, CAAI's matured methods and infrastructure allow the Center to engage with projects in ways that are both flexible and intentional. This visibility across the research landscape allows us to identify best approaches, whether that means rapid experimentation, methodological guidance, or deeper technical partnership, so that effort and resources are aligned with project goals. In doing so, the Center fosters inclusive collaboration while also supporting work with the strongest potential for translation, scalability, and lasting institutional impact.

Collaboration

CAAI has partnered with over 120 collaborators across 43 organizations globally.



CAAI has been the lead contributor for 115 AI-focused projects across multi-disciplinary domains and a participant in 40 additional collaborations, of which 8 are external.

“ My team and I engaged with the CAAI over 8 months ago to assist us in further developing AgriGuide, an AI-powered tool to generate human-quality text, answer queries, provide insights, and assist with research by harnessing the knowledge of the Martin-Gatton College of Agriculture, Food, and Environment and UK Cooperative Extension. The Center's involvement in the project has led to vastly enhanced functionality of BLUE through the CAAI's expertise and implementation of the most current AI models. CAAI has moved us forward in ways we would not have considered. ”

Craig Wood

Director of UK Cooperative Extension

Martin-Gatton College of Agriculture, Food and Environment

Working Together for the Commonwealth



Martin-Gatton College of Agriculture, Food & Environment | Louie B. Nunn Center for Oral History | College of Health Sciences | University Health Services | Creative Link for Advancing Digital Health | Center for Innovation in Population Health | Department of Communication | King Library | College of Pharmacy | College of Nursing Department of Computer Science | Institutional Research, Analytics & Decision Support



Sanders Brown Center on Aging | Internal Medicine | Office of Medical Education | Molecular & Cellular Biochemistry Department | Emergency Medicine | Engineering & Innovation in Medicine | Department of Neurology | Family & Community Medicine | Pulmonary Critical Care Unit| Spinal Cord & Brain Injury Research Center | Child Neurology | Department of Microbiology, Immunology & Molecular Genetics Cardiothoracic Surgery | Radiology | Cardiology | Intensive Care Unit



Eastern Kentucky University | Kentucky Community & Technical College System | University of Kentucky | UK Research Computing | University of Louisville | Morehead State University | Murray State University | Northern Kentucky University | Western Kentucky University



Capabilities

Bringing expertise across the AI stack from language and vision to agents and time-series models.



Multi-Modal Models

Conversational AI paired with image segmentation, object recognition, and classification.



Data Science & Analysis

Actionable insights uncovered through forecasting, classification and AI-powered analysis.



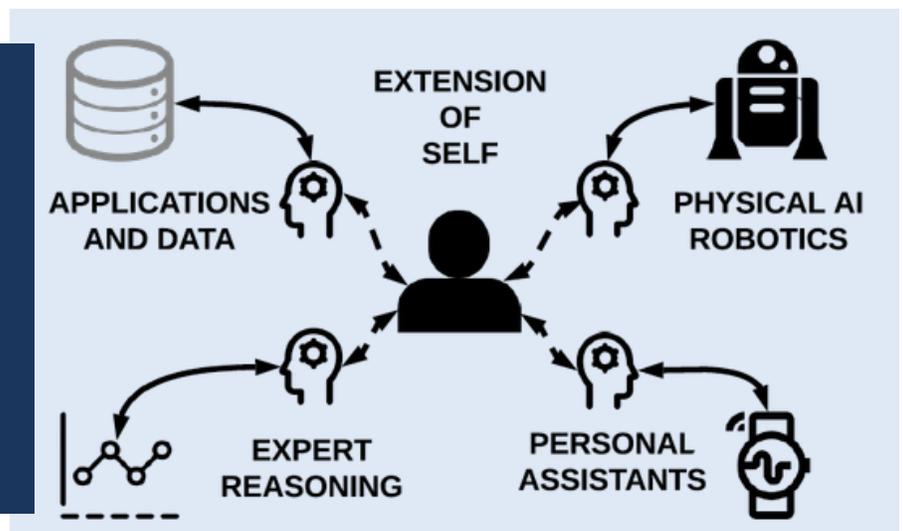
Sensors & Robotics

Integrating robotics, natural language processing, and sensor data for physical assistance



Agentic AI

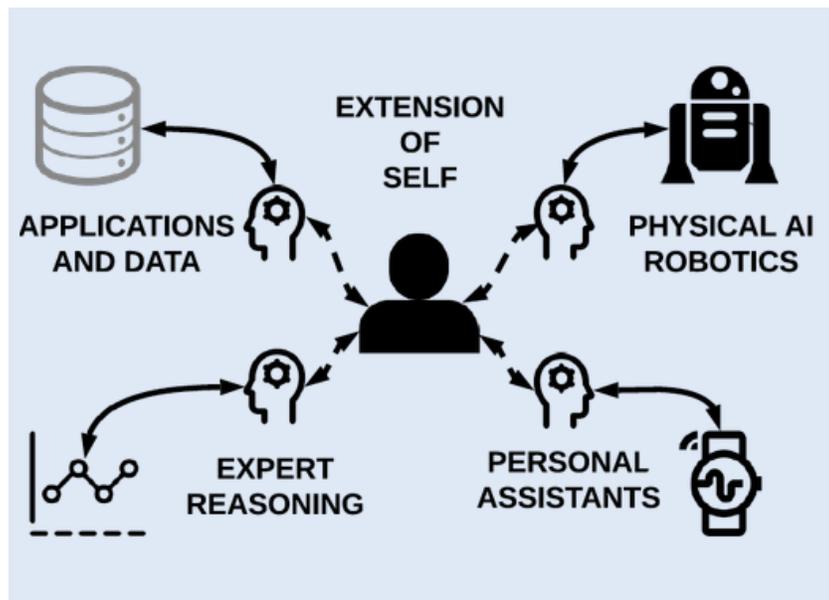
Using LLMs as agents to interpret data, make decisions, and take action, enabling humans to focus on high-value complex tasks.



Agentic AI Applications

Dynamic Task Automation for Data-Driven Systems

CAAI stands at the forefront of Agentic AI development. AI agents are autonomous systems that can perceive their environment, make decisions, and take actions to achieve specific goals, often integrating tools like LLMs, APIs, or other data sources to do so. By acting as an extension of human workflows, AI agents can handle burdensome tasks by building automation and streamlining processes. CAAI's expertise in producing robust data repositories, self-service agent-ready tools, managing real-time streaming data, implementing distributed and edge computing solutions, and conducting rigorous clinical testing through agent-enabled pipelines creates a powerful foundation for the effective development, deployment, and advancement of AI agents.



AI agents function as intelligent extensions of individuals and the broader workforce, augmenting decision-making and task execution across complex systems. They operate autonomously or collaboratively to streamline labor-intensive processes, reduce administrative burden, and enhance operational efficiency. By acting on behalf of individuals and teams, AI agents enable greater focus on high-value, strategic work while ensuring consistency, speed, and scalability in routine, data-driven tasks.

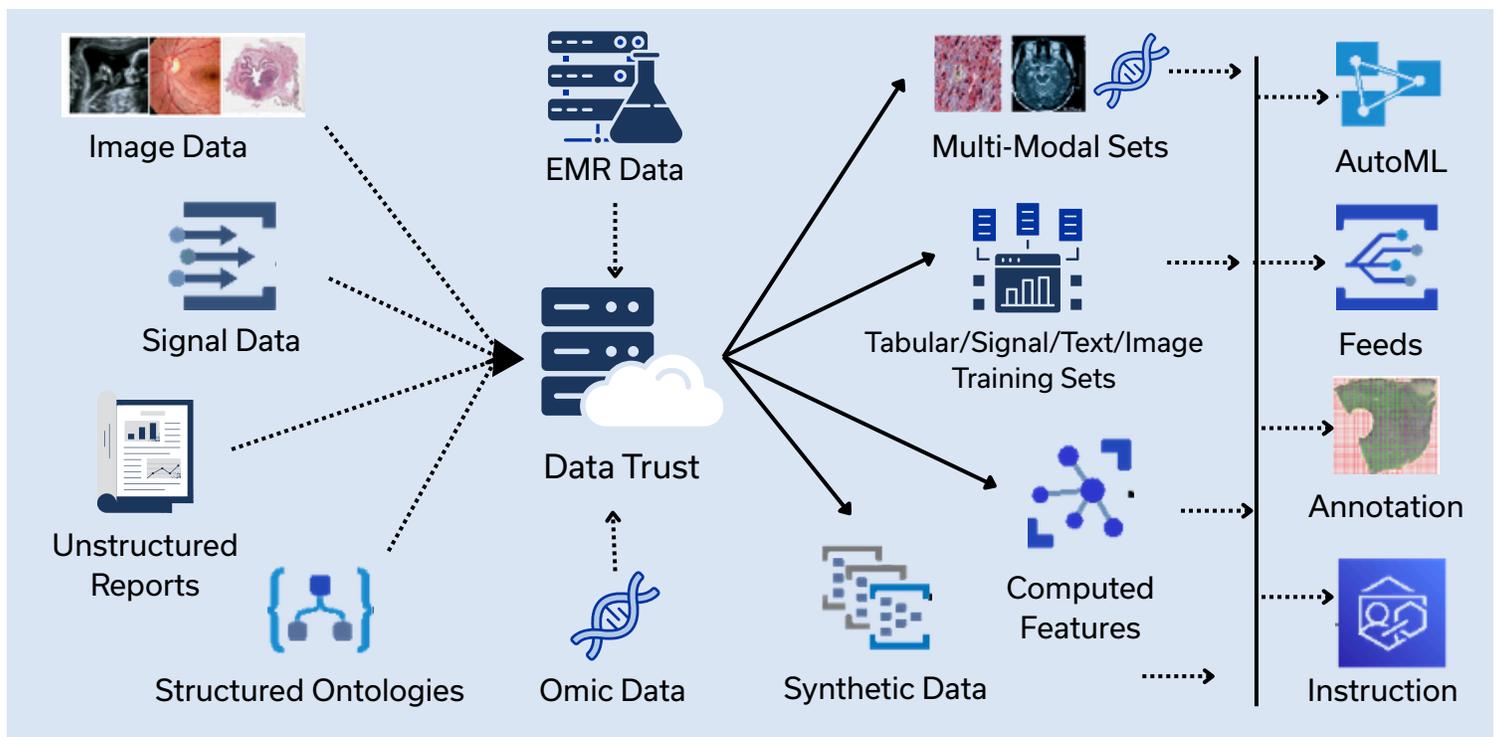
A few projects exploring agentic AI:

- *Virtual Lab Assistant*: Multi-agent system for research data, software development, and agent-based research project development
- *Knowledge Graph Explorer*: Agentic search, query, and exploration of large complex datasets
- *HL7 FHIR (EPIC) Explorer*: Agentic gateway to EMR data functioning as patients and providers
- *SmartState Systems*: Automate patient/research participant information gathering, conversation, and assessment using text messages and chat

AI-Ready Data Trusts

Orchestrating Secure, Multi-Modal AI Data at Scale

Multi-modal AI applications present several challenges, including the processing, storage, and distribution of large, protected datasets across distributed computational resources. CAAI develops, deploys, and operates AI-ready data platforms to manage and process multi-modal data (genomics, imaging, signal, and tabular information) across multiple locations. Using an agent-based system coupled with open-source automated machine learning (ML) and review tools allows not only dynamic load-balancing and cross-network operation, but also the development of research and clinical AI models using the data managed by the platform.



Provided Resources:

Slide Images

High-resolution slide images stored in open formats with associated image metadata

Case Reports

Slide gross details and corresponding final reports

AI Models

Software and templates to apply common deep learning models for Natural Language Processing (NLP) and image analysis

Associated Ontologies

Slide SNOMED, ICD codes, FHIR

Data Management Tools

Data query methods, tools to build training sets, and support for common transfer tools

Image Analysis

Slide, title, and cell-level metrics derived from image analysis

AI Platforms

Increasing access to open-source, user-friendly AI platforms.

Generalizable Tools for Common AI Needs

Researchers came to us with different projects **but the same core problems.**

We've built reusable, scalable platforms designed to remove AI barriers and support common research needs.

These platforms now enable:

- Reliable data gathering & participant engagement
- Clean, analysis-ready datasets
- No-code model building & predictive analytics
- Secure use of AI and LLMs in research workflows

These platforms are currently deployed in our secure, HIPPA and NIST 800-53 compliant environment. We maintain a consistent, shared security model that takes the protection of all data seriously and delivers secure, flexible solutions that support impactful AI projects and meaningful change. For local, customizable deployment, they are also open-source and available through our Github.

Infrastructure

CAAI leverages a combination of local, regional, and cloud-based data centers to support all application development and deployment. We have intentionally built this hybrid infrastructure to serve as a strong strategic partner to the Commonwealth of Kentucky, as well as to our research, educational, and industry collaborators. By creating an agile, future-resilient environment, we avoid dependence on any single infrastructure, vendor, or software stack. It enables our development teams to build applications using current best practices to drive innovation, reduce costs, and keep pace with the rapid evolution of the AI field.



CLASSify

Making Machine Learning Accessible for Clinical Staff

Clinicians often produce large amounts of data and classifying it is key to gaining insights or identifying trends that could lead to improvements in patient care. However, classifying data is a time-consuming process and leveraging AI to address this challenge typically requires technical expertise. CLASSify simplifies machine learning (ML) by providing an easy to use web-based platform where users can train and evaluate ML classification models on any tabular data.

Key features of CLASSify:

- Requires no technical expertise
- Customizable training parameters
- Results in tables or visualizations
- Synthetic data generation to bolster imbalanced class labels or create new datasets
- Explainability scores for deeper insights
- Easy model comparison for faster decision-making



Projects supported by CLASSify:

- College of Medicine researcher evaluating immune responses in people with dementia.
- Institutional Research, Analytics & Decision Support office predicting who will apply to UK using admissions data.
- College of Pharmacy researcher predicting patient risk for medication non-adherence and poor vascular risk factor control using claims and EHR data.
- College of Medicine researcher studying muscle-specific microRNA-1

Published Paper

Mullen, A. D., Armstrong, S. E., Talbert, J., & Bumgardner, V. C. (2024). [CLASSify: A Web-Based Tool for Machine Learning](#). AMIA Summits on Translational Science Proceedings, 2024, 364. PMID: 38827105

Projects supported by LLM Factory:

- One Good Choice: A tool that encourages healthier decisions, developed with University Health Services and the College of Health Sciences.
- Synthetic Personas: Conversational AI agents that make remote training interactive, in collaboration with the Center for Population Health and Creative Link for Digital Health, as well as an application for the Office of Medical Education.
- CELT Look-Up Tool: Enables conversational navigation of CELT's resources and website.

Published Paper

Klusty, M. (2025, March 11). [Institutional Platform for Secure Self-Service LLM Exploration](#). AMIA Informatics Summit
PMID: 40502230



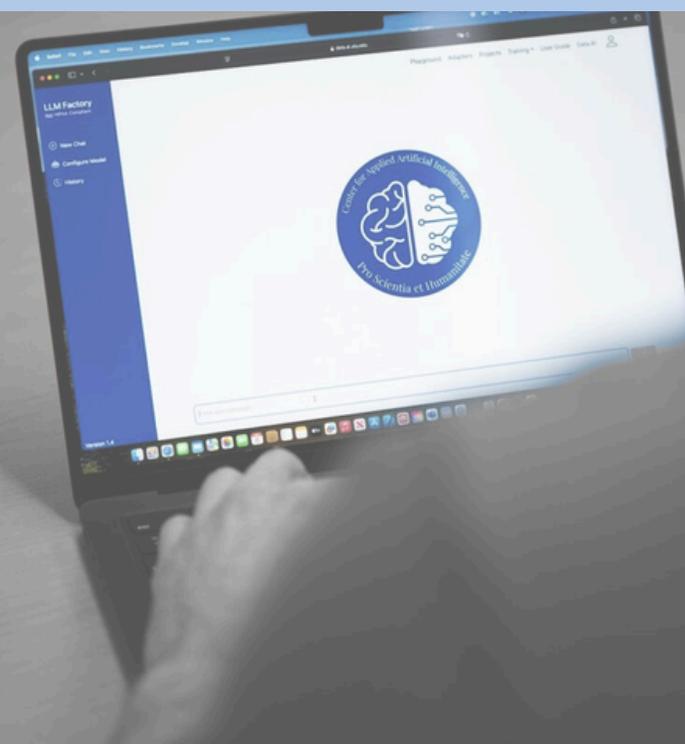
LLM Factory

Deploying Local and Secure Large Language Models

LLMs require significant investments in compute infrastructure, as well as specialized technical knowledge. The potential to advance research through the use of LLMs are restricted due to availability of resources and data security. CAAI's LLM Factory provides a secure, locally hosted platform where users can upload their own datasets, train adapters by layering data on a base model, privately configure and explore models, and expose models to external, OpenAI compatible API. LLM Factory supports the latest multi-modal and advanced reasoning models. The system offers researchers a free and secure alternative to public, commercially available LLM services.

Key features of LLM Factory:

- Users can control flexibility, and security without a programming or technical background
- Researchers can train models with the assurance data is secure in a NIST-compliant facility
- Open AI industry-standard API endpoints provides interoperability with other libraries, tools, and systems



SmartState

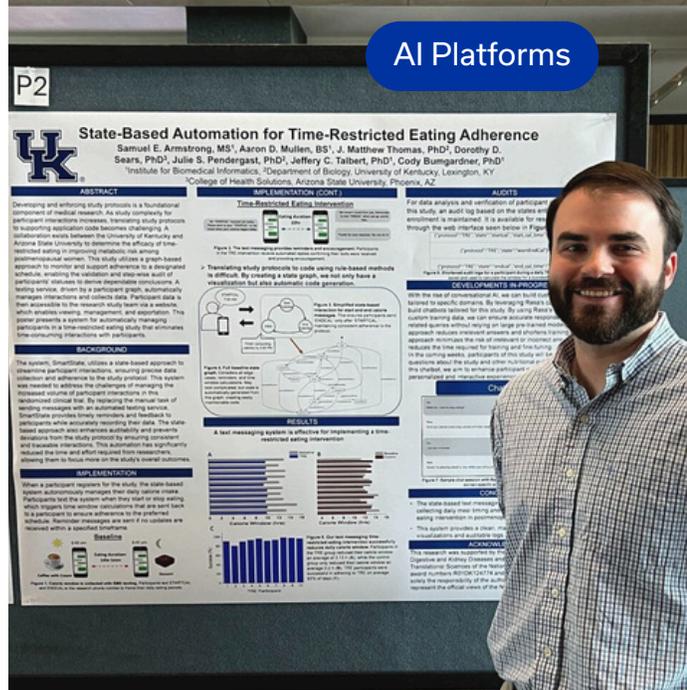
Improving Participant Compliance with Study Protocols

Enforcing study protocols and ensuring participant compliance is vital but often requires costly software or manual effort. To address these challenges, CAAI developed SmartState, an automated protocol adherence platform that improves compliance and streamlines manual processes. Virtual agents are used to guide participants through protocols, send email/text reminders, and document progress.

Key features of SmartState:

- Automated participant management reduces researcher workload with tools to track interactions, collect data, and prevent protocol deviations
- AI-powered communication enables natural language interactions to simplify participant engagement and data extraction
- Real-time updates send timely prompts and record responses to ensure compliance
- Web-based administration provides researchers with seamless access to logs, reports, and messaging utilities
- Scalability supports large studies with detailed audit trails to resolve disputes and enhance accountability

AI Platforms



Projects supported by SmartState:

- Time-Restricted Eating Intervention in Normal and Cognitively Impaired Postmenopausal Women
- Time-Restricted Eating and Sleep Intervention in College Students
- Optimization of Preoperative Treatment & Interactive Medical Assistance for Learning Cardiothoracic Surgery (OPTIMAL CT)
- Plant-Based Diet for Diabetes Prevention (PDDP)

Published Paper & Presentation

[Armstrong, S., et al \(2025, March 12\). SmartState: An Automated Research Protocol Adherence System. AMIA Informatics Summit PMID: 40502224](#)

caai.ai.uky.edu/model-based-programming-for-research-protocols/

Projects supported by Forecaster:

- RADOR: Forecasting opioid overdose counts across regions of Kentucky to support better intervention and reaction planning
- Emergency Department Arrival Prediction Model: Accurately forecast the number of walk-in patients that will arrive at each ED in a given day, up to a week in advance
- eICU Data Streams: High-level insights on continuous monitoring of ICU patients using vital signs

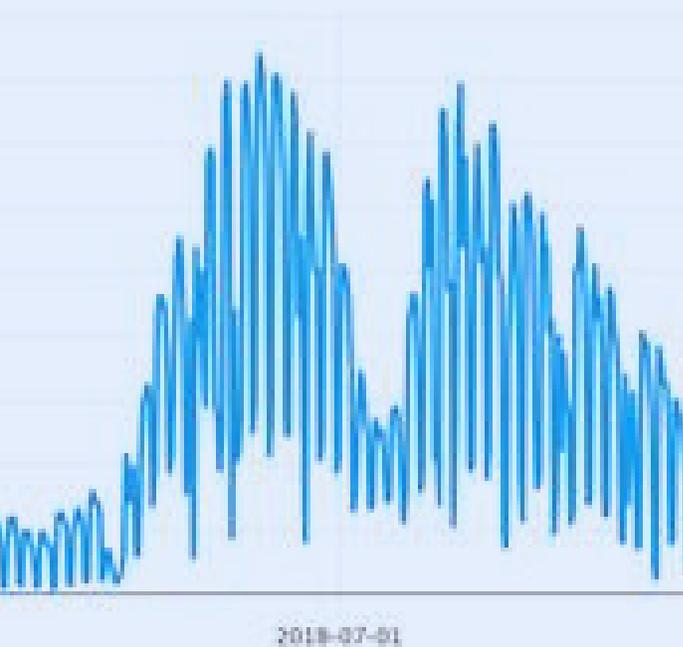
AI Platforms

Forecaster

Evaluating and Exploring Timeseries Data with Machine Learning

Many clinical questions depend on continuous or episodic measurements at both individual (vitals, wearable sensors) & population levels (epidemiology), however forecasting models can be difficult to correctly implement, particularly for researchers without deep expertise in statistical or machine learning methods. Forecaster addresses this challenge by providing a user-friendly, web-based platform that streamlines model training, evaluation, and comparison across multiple forecasting approaches. By lowering technical barriers, Forecaster supports faster experimentation and more reproducible forecasting workflows across disciplines.

Time Series Forecast- random-fores



Key features of Forecaster:

- Built-in tools for handling missing data and other preprocessing tasks
- Intuitive visualizations to support interpretation
- Accessible web-based interface lowers technical barriers

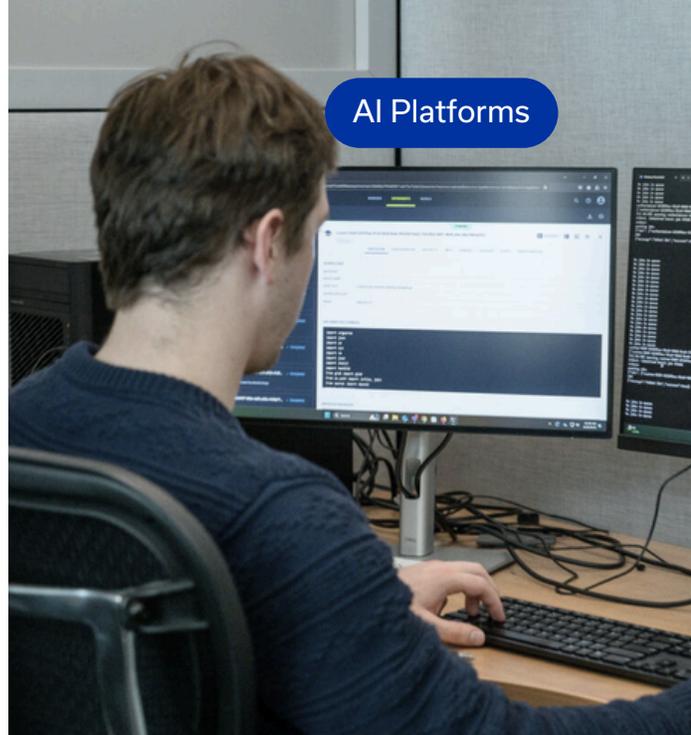
CAT-Talk

Using AI to Drive Innovation in Medical Transcription

The increasing demand for administrative documentation in healthcare takes time away from patient care and contributes to staff burnout. Commercially available transcription services often struggle with complex medical conversations, come with high costs and pose data security concerns. CAT-Talk, CAAI's web-based transcription platform, addresses these challenges by providing accurate, speaker-labeled, time-stamped transcriptions from audio and video recordings. CAT-Talk significantly reduces the time spent on manual transcription, giving clinicians more time to focus on patient care.

Key features of CAT-Talk:

- Fast, accurate transcriptions with error flags for rapid human verification
- Integration with other LLM tools for summarization, theme extraction, and highlighting key takeaways
- Hosted on secure, UK-owned NIST-53, HIPAA-compliant infrastructure with data encrypted at rest and in transit
- Customizable tools tailored to clinicians' needs



AI Platforms

Projects supported by CAT-Talk

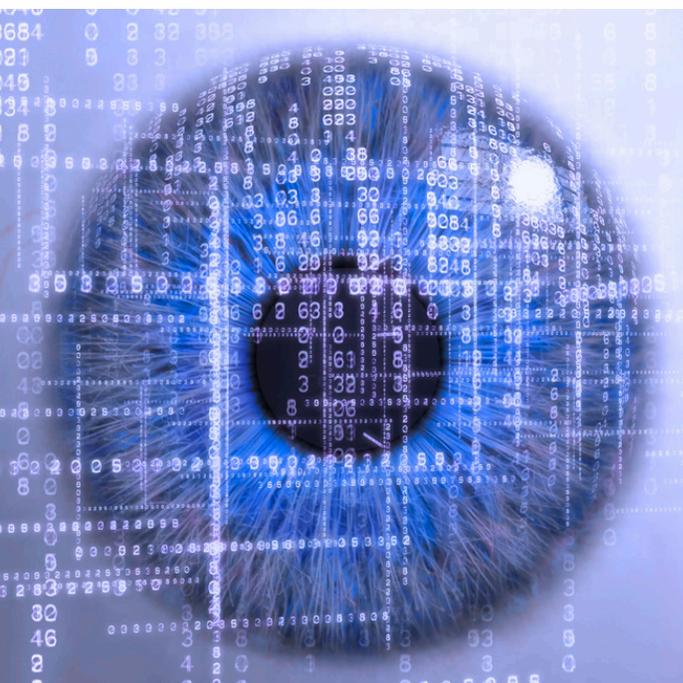
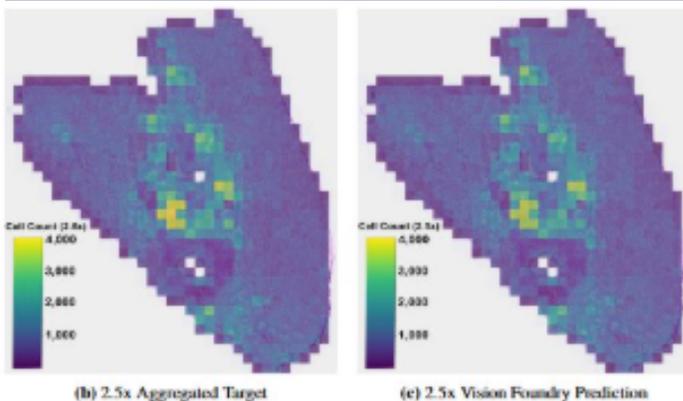
- **SpeakEZ:** Transcribing thousands of interviews from UK Libraries' Nunn Center for Oral History.
- **Medical Transcriptions:** Transcribing and summarizing synthetic patient-provider conversations.
- **Translation Tools:** Supporting a UK History professor in transcribing and translating Turkish interviews to English.

Published Paper & Presentation
Logan, W. V., et. al (2025, March 13).
[Toward Automated Clinical Transcriptions.](#)
AMIA Informatics Summit.
PMID: 40502215



Projects supported by Vision Foundry:

- Bone Histopathology Annotation Tool: Creates automatic annotations of bone histology slides identify osteoblast and osteoclast cells
- Foundational Cancer Pathology Model: Improving foundational model training by filtering out low-quality or non-informative image regions



Vision Foundry

Adapting & Deploying Foundational Vision Models

Imaging research can be time consuming and costly, creating a bottleneck for medical insights. Vision Foundry streamlines this work by leveraging an advanced AI framework within a user-friendly interface. Supporting a wide array of downstream tasks, Vision Foundry enables researchers to perform segmentation, classification, annotation, and regression on diverse image formats. Whether working with Whole Slide Images (WSIs) or CT scans, Vision Foundry's flexibility allows for comprehensive analysis and interpretation of medical images. One of the standout features is its self-supervised learning capability through the DINO-MX training framework. This framework utilizes a multi-expert, multi-scale approach, incorporating techniques such as LoRA (Low-Rank Adaptation) and PEFT (Parameter-Efficient Fine-Tuning) to enhance model performance. This ensures that the models are robust and adaptable across various imaging tasks.

Key features of Vision Foundry:

- Create multi-purpose, versatile foundational models
- Secure dataset governance on a HIPAA-compliant DGX cluster
- Automated annotation to reduce labor and cost of image labeling

Projects

Turning data into real-world impact with applied AI.



*I have been collaborating with CAAI for the past six months to develop the SpeakEZ system, which I have envisioned for several years, but had no way to implement. That is, until I connected with CAAI. I do not exaggerate when I say my **collaboration with CAAI has changed everything for my center.***



Doug Boyd

Director, Louie B. Nunn Center for Oral History

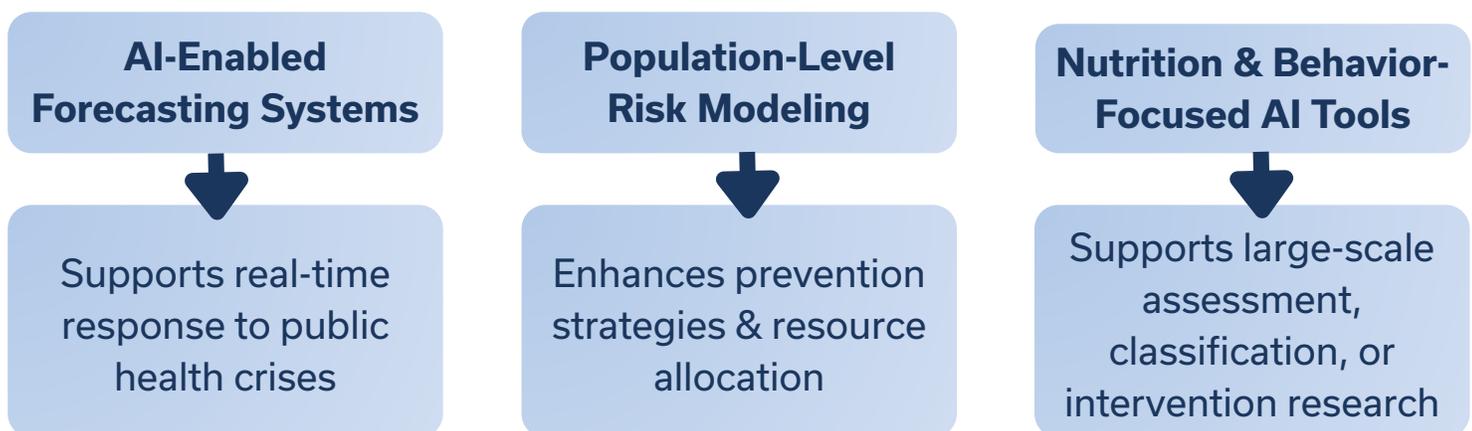
University of Kentucky Libraries

Projects



Nutrition and Public Health

ACCELERATING POPULATION-LEVEL INSIGHT AND RESPONSE



Population-level insights in public health and nutrition often depend on data that are fragmented across sources, inconsistent in structure, and difficult to interpret at scale. CAAI accelerates public health action by transforming these complex, disconnected data streams into timely, actionable insights, and by developing scalable tools that can be generalized across populations, settings, and contexts. By integrating diverse data sources, we support learning public health systems that enable earlier detection of risk, more precise guidance of interventions, and rigorous evaluation of population-level outcomes. In a true learning system, data are not collected solely for reporting; they are continuously integrated, analyzed, and acted upon, then reevaluated as conditions evolve. AI plays a critical role in this cycle by making it possible to synthesize high-volume, high-dimensional data, uncover patterns that would otherwise remain hidden, and adapt insights in near real time as new information becomes available. We've build forecasting systems that provide real-time support and response to public health crises, models that identify risk to support early intervention and resource allocations, and nutrition and behavior-focused tools that can support large-scale assessment or interventions in a timely manner.



Projects

Forecasting Emergency Department Arrivals

Applying AI to Support Operational Decision-Making

The Emergency Department Prediction project utilizes patient arrival data from the University of Kentucky's Chandler and Good Samaritan hospitals. Through this data, CAAI can determine an accurate count of how many walk-ins the emergency departments (EDs) at each location see each day. The goal of the project is to accurately forecast the number of walk-in patients that will arrive at each ED in a given day, up to a week in advance. With these predictions, informed decisions could be made by hospital staff to determine, for example, how many transfer patients to accept on that day to avoid overwhelming the hospital or the staffing needs in the ED that day.

The forecasting is performed using a Temporal Fusion Transformer model architecture, which is a deep learning method specifically built for time series forecasting. This model can learn from previous trends in the data to create forecasts for future arrivals. It can use temporal relationships between the data to identify trends and patterns. For example, over the course of an average week, the number of ED arrivals will follow a regular pattern over each day of the week that can be modeled and forecasted into the future. Additional variables, called covariates, can also be used to improve the prediction accuracy. For example, we use local weather data, such as temperature and precipitation, as these factors have also been found to be associated with changes in ED arrivals. By leveraging these forecasting capabilities, the Emergency Department Prediction Project supports proactive resource planning in emergency healthcare settings.



Projects

One Good Choice

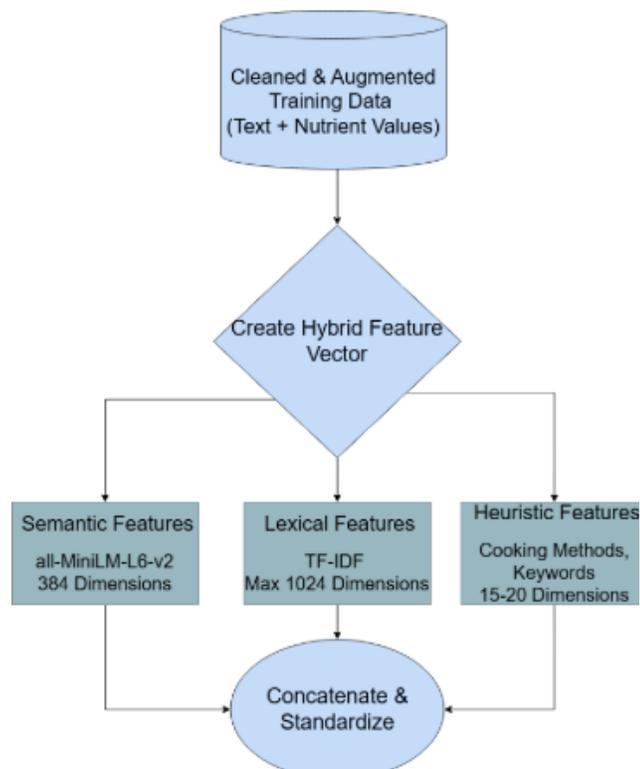
Supporting Healthier Nutrition Decisions

Dietary choices play a central role in long-term health, yet many people struggle to understand how nutritious their meals truly are. Most existing food trackers place the burden on individuals to log meals after the fact, offering little guidance at the moment decisions are made. One Good Choice (1GC) was developed to shift nutrition support from passive tracking to proactive decision-making. Rather than recording what someone has already eaten, 1GC engages users at the point of choice, helping them make one healthier decision at a time.

The project centers on an accessible, evidence-backed tool that translates text-based food descriptions into clear and actionable nutritional insights about a food’s overall healthfulness, calorie content, and nutritional balance. Importantly, the system also suggests comparable but healthier alternatives, gently nudging users toward improved options.

1GC draws from multiple trusted nutrition databases and applies advanced AI techniques to assess the nutritional quality of potential meals. Complex data are translated into text explanations and visual cues, making nutrition information easier to interpret and act on. We use machine learning to bridge the gap between how people talk about food and how nutrition is traditionally measured. This underlying technology enables scalable nutritional guidance even when detailed ingredient data are unavailable; an important step toward broader access and real-world applicability.

Currently in development in collaboration with health and wellness experts from the College of Health Sciences and University Health Services, One Good Choice aims to support healthier eating across Kentucky and beyond. By combining evidence-based nutrition science with accessible design, the project illustrates how AI-driven tools can advance public health through informed, everyday decision-making.





Projects

CMS Star Quality Investment Optimizer

Supporting Strategic Investments in Healthcare Quality Improvement

The Center for Medicaid and Medicare (CMS) STAR rating system is a quality measurement framework that assigns hospitals a rating from 1 to 5 stars based on 48 different quality measures across five categories: mortality, safety, readmission, patient experience, and process measures. This rating system has significant financial implications for hospitals through Medicare payment adjustments in programs like the Hospital Readmission Reduction Program (HRRP) and the Hospital Value Based Purchasing Program (HVBP), while also influencing public perception and patient choice.

The CMS Star Quality Investment Optimizer system standardizes and weighs these measures to create a single, easy-to-understand rating that helps patients compare hospitals and make informed healthcare decisions. This project includes the development of a Python-based calculator tool that significantly improves the speed of existing SAS-based calculations, allowing for high-speed simulation of the scoring impacts of hypothetical strategic investments. The tool allows hospitals to input their statistics and receive detailed analysis of their performance, including the impact of individual measures on their overall score. The presentation also analyzes the University of Kentucky's specific performance, identifying key negative and positive features affecting their rating, and demonstrates how a 10% improvement in certain metrics could significantly impact their score.



Projects



[R01DA057605-01](#)
[R01DA057605-01S1](#)
[R01DA057605-01S2](#)

RADOR

Rapid Actionable Data for Opioid Response in KY

Opioid use disorder (OUD) remains a persistent public health crisis and epidemic. In Kentucky, 79% of drug overdose fatalities involve opioid substances. Efforts to reduce opioid overdoses and support opioid overdose control and prevention are often limited by delays in data availability, fragmented data systems, and varying local needs. To address this challenge, the Rapid Actionable Data for Opioid Response in Kentucky (RADOR-KY) team is building a statewide surveillance system to provide real-time data for effective opioid crisis management.

By aggregating Emergency Medical Services (EMS) response data at multiple geographical levels, RADOR-KY forecasts opioid overdose incidents, enabling state and local agencies to allocate resources and target interventions proactively. This predictive approach helps identify areas with rising overdose risks, ensuring timely responses that could reduce fatalities and improve patient outcomes.

CAAI provides key research support through machine learning and forecasting methods, enhancing the system’s ability to deliver accurate, actionable insights. RADOR-KY's scalable system allows for ongoing improvements in data quality and responsiveness, offering valuable support in addressing Kentucky’s opioid crisis.



Presented at



AMERICAN PUBLIC HEALTH ASSOCIATION
For science. For action. For health.

Harris, D. (2024, Oct. 29). Responding to evolving public health data needs: Building rapid actionable data for opioid response in Kentucky. <https://apha.confex.com/apha/2024/meetingapp.cgi/Paper/554240>

caai.ai.uky.edu/rapid-actionable-data-for-opioid-response-in-ky/

Projects

Clinical Applications



ENHANCING DIAGNOSTIC SUPPORT & CLINICAL DECISION-MAKING



Diagnostic support in clinical care is inherently complex, requiring the synthesis of large volumes of heterogeneous data under time pressure and in high-stakes environments. CAAI addresses this challenge by partnering on AI-assisted diagnostic and decision-support tools that enhance interpretation, strengthen patient monitoring, and help clinicians identify the right interventions earlier. By leveraging clinical data generated through routine care, we support learning healthcare systems that improve the speed, accuracy, and consistency of decision-making at critical moments. These systems use data not only to inform real-time clinical action, but also to test interventions, evaluate outcomes in real-world settings, and continuously refine care delivery over time. Rather than static tools, our efforts create a continuous feedback loop between data, clinical decisions, and patient outcomes, enabling care systems to adapt and improve as new evidence emerges.



Projects

Published Paper

Brasher, M., Virodov, A., Raffay, T. M., Bada, H. S., Cunningham, M. D., Bumgardner, C., & Abu Jawdeh, E. G. (2024). Predicting Extubation Readiness in Preterm Infants Utilizing Machine Learning: A Diagnostic Utility Study. *The Journal of pediatrics*, 271, 114043. |DOI: [10.1016/j.jpeds.2024.114043](https://doi.org/10.1016/j.jpeds.2024.114043)

Extubation Readiness in Preterm Infants

Clinical Decision Support from Timeseries Signal Data

Machine learning analysis has the potential to enhance prediction accuracy of extubation readiness in preterm infants while utilizing readily available data streams from bedside pulse oximeters and ventilators.

The objective of this study was to predict extubation readiness in preterm infants using machine learning analysis of bedside pulse oximeter and ventilator data. This observational study used prospective recordings of oxygen saturation (SpO₂) and ventilator data from infants <30 weeks of gestation age. Research pulse oximeters collected SpO₂ (1 Hz sampling rate) to quantify intermittent hypoxemia (IH). Continuous ventilator metrics were collected from bedside ventilators. Data modeling was completed using unbiased machine learning algorithms. Three model sets were created using the following data source combinations: (1) IH and ventilator (IH + SIMV), (2) IH, and (3) ventilator (SIMV). Infants were also analyzed separated by postnatal age (infants <2 or ≥2 weeks of age). Models were compared by area under the receiver operating characteristic curve (AUC).

A total of 110 extubation events from 110 preterm infants were analyzed. Infants had a median gestation age and birth weight of 26 weeks and 825 g, respectively. Of the 3 models presented, the IH + SIMV model achieved the highest AUC of 0.77 for all infants. Separating infants by postnatal age increased accuracy further achieving AUC of 0.94 for <2 weeks of age group and AUC of 0.83 for ≥2 weeks group.

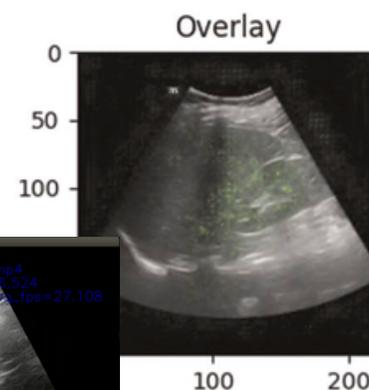
FAST Ultrasound

AI Assisted Evaluation of Focused Assessment with Sonography in Trauma

The focused assessment with sonography in trauma (FAST) is an ultrasound protocol used by over 96% of trauma 1 medical centers to identify the location of life-threatening hemorrhage in a hemodynamically unstable trauma patient. This project provides an AI model to assist in interpretation of the FAST examination abdominal views, as it pertains to adequacy of the view and accuracy of fluid survey positivity. FAST images were acquired from the UK Chandler Medical Center, a quaternary care level 1 trauma center with more than 3,500 adult trauma evaluations. The model can detect positivity and adequacy of FAST examinations with 94% and 97% accuracy, aiding in the standardization of care delivery with minimal expert clinician input. This work demonstrates AI as a feasible modality to improve patient care imaging interpretation accuracy and demonstrates its value as a point-of-care clinical decision-making tool.

Published Paper

Levy, B. E. MD, MPH; Castle, J. T. MD, PhD; Virodov, A. MS; Wilt, W. S. MD; Bumgardner, V.K. PhD; Brim, T. DO; McAtee, E. DO; Schellenberg, M. MD, MPH; Inaba, K.i MD; Warriner, Z. D. MD. (2023) Artificial intelligence evaluation of focused assessment with sonography in trauma. *Journal of Trauma and Acute Care Surgery* 95(5):p 706-712, | DOI: 10.1097/TA.0000000000004021



AI-Enhanced Clinical Trial Matching

Accelerating Trial Screening Through Automated Eligibility Review

Identifying appropriate clinical trials is a manual, time-consuming, and resource-intensive practice that leads to limitations in matching patients to potentially life-extending treatments. Recent advancements in LLMs and agentic AI show strong promise in this space, with federal initiatives such as NIH's TrialGPT [1] project reflecting broader momentum toward AI-powered eligibility screening tools. However, real-world implementation still faces a few key challenges: integrating heterogeneous electronic health record (EHR) data, facilitating expert review and interpretability, and maintaining rigorous security standards. All of which are necessary for real-world implementation.

To address these needs, CAAI has developed an AI pipeline for unstructured and structured EHR data, including lab results, genetic testing, and free-text clinical notes. Leveraging open-source reasoning models on our institutionally hosted, NIST-compliant platform LLM Factory, our system evaluates patient eligibility against trial protocols and produces detailed, referenced justifications for each eligibility decision, facilitating human-in-the-loop oversight and ensuring that security standards are upheld. These efforts build on the foundational approach of TrialGPT, extending it to support more diverse clinical inputs and more transparent reasoning. The templated clinical trial screening framework was designed with input from experts at the Molecular Tumor Board and has been utilized with synthetic patient data; validation with real-world datasets is the next step.

CAAI's goal is to create an AI-assisted trial matching tool that accelerates patient eligibility screening, expanding the pool of trials considered and enabling coordinators to maximize their time. Effective translational science requires tools that are both cutting-edge and accessible, bridging advances in technology with clinical practice. Our effort is toward a secure, scalable, and transparent AI system that enhances clinical trial matching, saving providers time and expanding a patients' opportunities for trial consideration.

[1] Jin, Q., Wang, Z., Floudas, C.S. et al. Matching patients to clinical trials with large language models. *Nat Commun* 15, 9074 (2024). <https://doi.org/10.1038/s41467-024-53081-z>

HeartLens

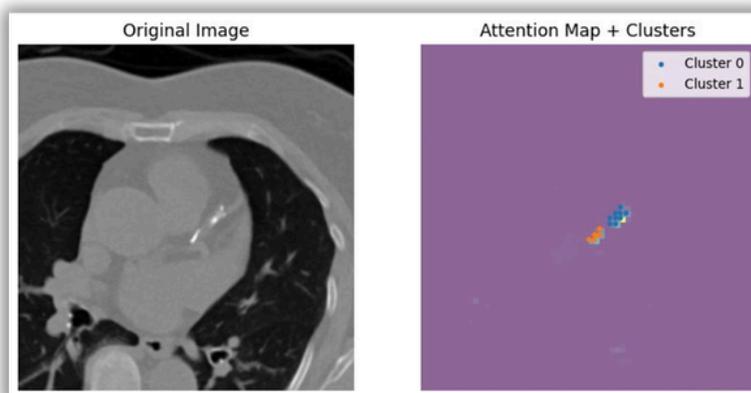
Improving the Accuracy of Cardiovascular Diagnostic Tools

Coronary artery calcification (CAC) scoring helps assess cardiovascular disease severity but relies on radiologists manually reviewing CT scans to identify small, easily overlooked calcium deposits. This process is critical for early detection and intervention but is prone to human error.

Through an EXCEL Research Committee effort, HeartLens is a collaborative project involving the UK Divisions of Radiology & Cardiology, the Department of Computer Science, and CAAI. The goal of HeartLens is to develop an AI-based tool to assist radiologists in reviewing CT scans, detecting CAC, and informing cardiologists' diagnostic and treatment decisions. Early detection of calcification enables more timely, less invasive interventions.

HeartLens uses the DINO Transformer Model, a computer vision AI applied to identify patterns in CT scans without requiring manual labeling. By analyzing UK and Stanford University datasets, the model extracts and highlights calcified areas in coronary arteries, color-coding them by severity to aid clinical review. These visual cues support tasks such as classification and segmentation and can integrate with LLMs to enhance diagnostic accuracy. Beyond CAC scoring, the tool has potential applications for detecting other heart conditions and the long-term goal is to make it available as a web-based tool within CAAI's self-service platform, CLASSify. This would streamline clinical decision-making, improve early disease detection, and foster further research.

HeartLens has the potential to detect calcium deposits in the heart earlier, leading to timelier interventions and less invasive and aggressive patient treatment options.



Funded

EXCEL Research Initiative



Projects

Reasoning Robots

LLM Powered Health Assistants

CAAI has integrated multi-modal AI models, robotic platforms, and sensor devices, to bring AI into the physical world. Our Temi robot is capable of navigating complex environments like hospitals to assist in patient way finding and patrol patient rooms. Making use of onboard devices, the robot allows models to see, speak, and listen. Additionally, Temi streams live video feeds processed by models to detect when individuals have fallen, adding to it's ability to effectively monitor clinical environments.

Powered by LLM Factory, Temi engages in natural conversations and responds to user requests during patrols. The LLM serves as the robot's brain, managing goals and choosing the correct actions based on the environmental context. By leveraging new foundational models, Temi's reasoning capabilities and autonomous decision-making capabilities are continuously improving. Through the establishment of LLM-driven robotic control systems, CAAI is paving the way for the clinical use of low-cost humanoid robots, which are anticipated to be available in late 2025 and reach mass availability in 2026.

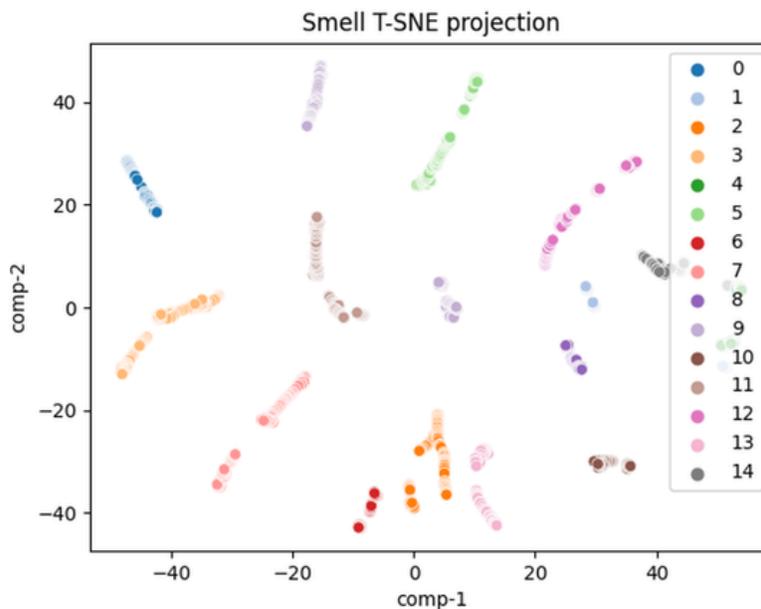


Environmental Monitoring

Robotic Sensing Platforms

Physical AI, also known as embodied AI, involves AI systems controlling and learning from physical hardware like robotic arms, mobile robots, and medical devices. In healthcare, this can include surgical robots that learn to perform precise procedures, rehabilitation robots that adapt to each patient's needs, and personal health assistants to passively monitor health data and actively assist patients.

CAAI has integrated a smell sensor with our "Temi" robot, enabling it to gather scent data across 64 smell channels, which can be used to identify specific odors in real-time. By combining Temi's mobility with this advanced smell detection, the robot can monitor environments such as assisted living homes or hospital floors, identifying unexpected gases or abnormalities. In assisted living settings, for example, Temi can track bodily waste functions and alert care staff to potential issues. Additionally, the real-time temperature and humidity monitoring feature offers valuable insights in temperature-sensitive environments, like hospital floors, allowing for timely alerts when conditions deviate from the norm.



OPTIMAL CT

Optimizing Patient Adherence to Pre-Surgical Treatment

Beta blockers and other medications administered prior to cardiovascular surgery have been shown to reduce adverse outcomes for patients. The Society of Thoracic Surgery maintains a publicly available database of adherence rates across the country. Nationally, 94% of patients take their prescribed medications 24-hours prior to surgery, however, for University of Kentucky Healthcare patients, that number decreases to 78.3% across a 3-year period. This gap highlights an important opportunity for improvement.

In collaboration with UK Healthcare, CAAI is developing OPTIMAL CT, a solution that uses virtual assistants and messaging to help patients follow pre-surgical treatment plans and enhance engagement. The intention is to virtually guide patients through a treatment plan to improve beta-blocker medication compliance.

Powered by CAAI's SmartState platform, OPTIMAL CT monitors patient progress through specific phases of the prescribed pre-surgical treatment plan. The system automates communication through text and email reminders and uses natural language processing to record patient responses in real-time, storing all interactions in a secure database.

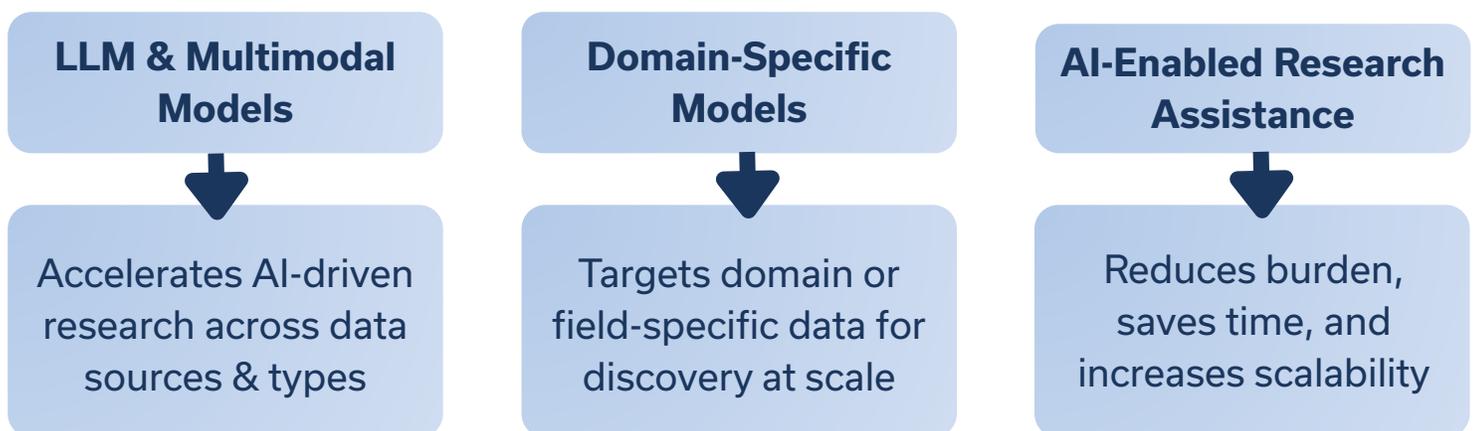
Additional long-term objectives include developing a repeatable process and solution that could be applied to other common preoperative patient issues such as discontinuance of blood thinners, oral antibiotics administration, or wound site bathing.

Projects

Research & Discovery

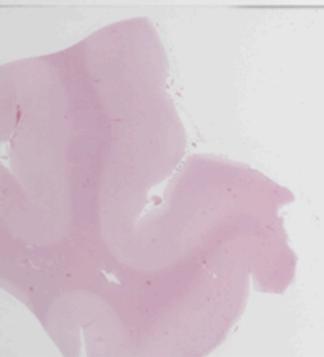


IMPROVING LARGE-SCALE SCIENCE WITH MULTIMODAL AI

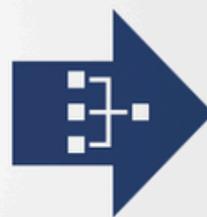
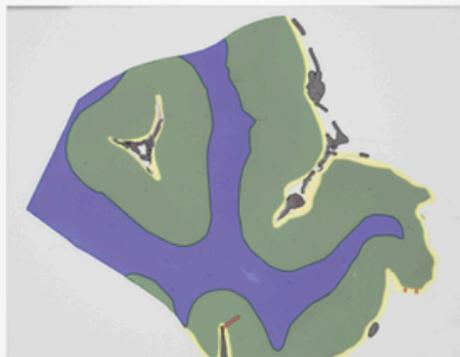


Research has become increasingly more challenging as the volume of scientific data continues to expand. Scientific data are multimodal, high-dimensional, and often distributed across instruments, formats, and disciplines. CAAI addresses these challenges by developing adaptable, foundational AI systems to accelerate discovery and make advanced analytics more accessible across scientific fields. By transforming raw, multimodal research data into searchable, analyzable evidence, we support learning research systems that enable reproducible workflows, rapid hypothesis generation and testing, and cross-domain insight. AI-enabled research tools reduce the burden of routine analytical tasks, save researcher time, and increase scalability, allowing scientific teams to focus effort on interpretation, innovation, and translation. Rather than static pipelines, our approaches create continuous feedback between data, models, and scientific insight, improving research efficiency and impact over time.

Slide Image



Annotations



Model Predictions



Projects



[U24NS133945-01](#)

[U24NS133949-01](#)

Brain Research & Diagnostic Platform

Internationally Federated Platform for AI Research and Diagnostics

The development of AI and ML models for neuropathology is often hindered by the scarcity of high-quality, well-annotated training data. Insufficient data makes it challenging to train robust models, resulting in suboptimal performance and impeding progress in research.

The Brain Digital Slide Archive (BDSA) project aims to address these challenges by enabling the integration of AI into neuropathology. BDSA is an international collaboration of research institutions, working to design a federated system for sharing neuropathology slide images and annotations. The project focuses on developing tools that facilitate seamless sharing of slide images between partner institutions and streamline the annotation process. These annotated datasets will inform AI models capable of accurately segmenting and detecting anomalies in neuropathology images, thereby accelerating research and innovation in the field.

The methodologies and tools developed through the BDSA project have applications far beyond neuropathology. The same federated systems and AI-powered approaches can be adapted for use in other domains that rely on large-scale image analysis and annotation, such as oncology, radiology, and other areas of medical imaging. Addressing foundational challenges in data sharing and annotation, the BDSA project has the potential to drive AI innovation across a broad spectrum of disciplines.

Patient Note Extraction

Automating Clinical Variable Extraction

Access to reliable clinical data is a foundational requirement for medical research, yet much of the information that determines study eligibility, outcomes, and risk factors remains locked inside narrative clinical notes. Imaging reports, encounter summaries, and discharge notes are rich in detail but difficult to analyze at scale. Today, researchers often spend weeks manually reviewing charts to extract basic variables before any scientific questions can be addressed. This work is time-consuming, costly, and prone to inconsistency, creating a significant bottleneck between data access and research driven- discovery.

The Patient Note Extraction Tool is designed to address this challenge and transform unstructured clinical text into research-ready datasets in a reliable and repeatable way. The core insight behind this project is that automation, if designed with appropriate safeguards and transparency, can shift clinical data preparation from a manual craft into a scalable research service. Our Patient Note Extraction Tool converts free-text clinical documentation into structured variables that researchers can immediately use for analysis. Investigators define the clinical features they need, such as diagnoses, dates, or specific events, and the system produces standardized, machine-readable outputs in familiar research formats. Rather than replacing expert judgment, the tool is designed to support it: users can review extracted results and validate accuracy before downstream use. The tool exists to accelerate time to insight, increase data quality, and expand access to high-value datasets.

The system's effectiveness was demonstrated through a proof-of-concept collaboration with the Spinal Cord and Brain Injury Research Center where the tool's extracted variables showed strong alignment with clinician annotations, exceeding 82 percent agreement across nearly all measures. What previously required over 50 hours of manual review was reduced to under an hour of expert verification, illustrating a substantial gain in efficiency. Currently, the broader Patient Note Extraction Tool is in development, with a web-based interface underway to allow non-technical users to configure extraction needs independently.

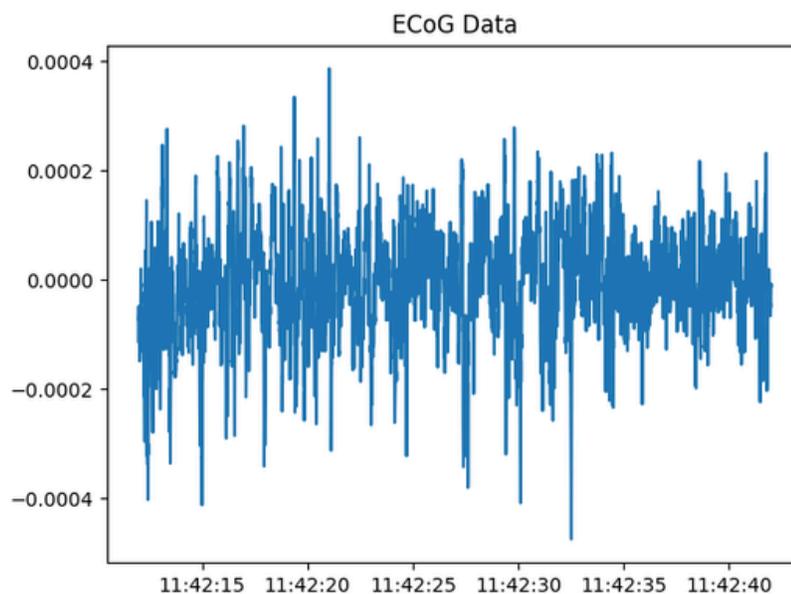
Multi-Modal ML Framework

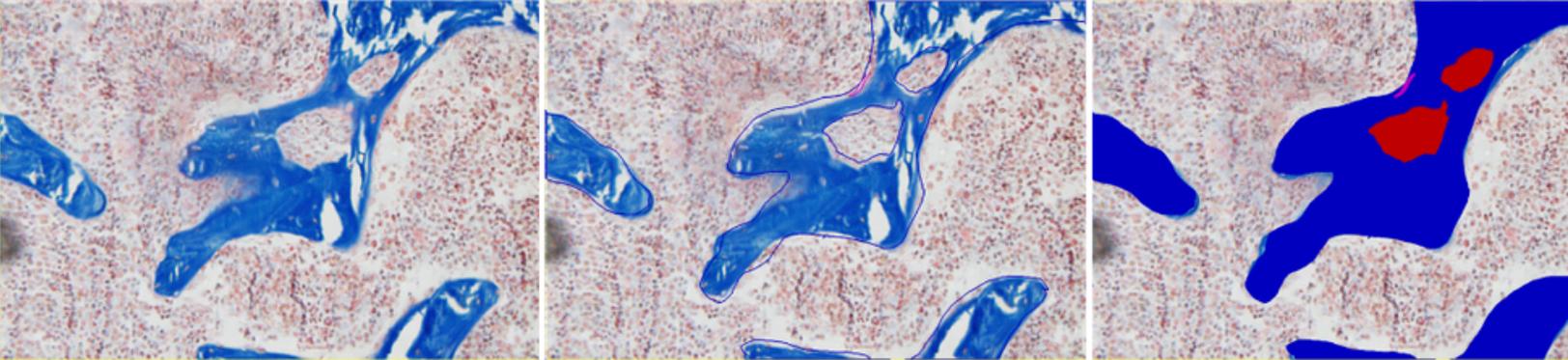
Supporting Automated Seizure Detection

Seizure detection in epilepsy research faces significant challenges due to class imbalances, where non-seizure periods vastly outnumber seizure events, leading to high false-positive rates with traditional methods. To address this, CAAI developed a multi-modal machine learning framework that integrates data from multiple sources to enhance detection accuracy:

- Electrocorticography (ECoG) readings
- Piezoelectric motion sensor data
- Video recordings

By leveraging diverse data sources, it reduces false positives and enhances the reliability of seizure detection. Additionally, the system enables automated, continuous monitoring of laboratory animals, improving the efficiency of epilepsy studies and supporting more robust research outcomes.





Projects

Bone Histopathology Annotation Tool

Scaling Annotation for Bone Analysis

Traditional bone histomorphometry focus on quantifying static volumes and surfaces to diagnose metabolic diseases, such as osteoporosis. CAAI is pushing innovation in this area by utilizing deep learning to characterize functional states within the mineralized bone tissue. This project seeks to use computer vision for semi-automated slide annotation that identifies cell characteristics associated with different bone turnover rates. Such an approach shifts the focus from simple structural measurement to a deeper understanding of tissue quality and metabolic trajectory, enabling more personalized short- and long-term treatment planning for complex bone and kidney diseases.

This project began with a small, highly specialized dataset of just over 400 pathology images, far fewer than what is typically required to train deep learning models effectively. To mitigate this constraint, we applied a tiling and segmentation-based methodology in combination with the DINOv2 foundation model. This approach substantially increased the number of usable training samples while preserving local structural and spatial features relevant to bone biology despite severe data scarcity.

Equally central to the project's success is the deep involvement of clinical domain experts from the College of Medicine's Division of Nephrology, Bone and Mineral Metabolism. These collaborators provided critical definitions and annotations of key biological features as well as expert insight into how positional and spatial relationships between these features correspond to biological function and tissue turnover. This locational knowledge was essential for guiding model development and interpretation, ensuring that computational outputs align with clinically meaningful concepts.

Beyond model development, the project delivers a user-friendly interface that supports exploration and semi-automated annotation of bone histology images. By enabling scalable annotation of mineralized bone tissue states, this tool not only advances automated pathology analysis but also helps generate a unique, high-quality dataset that can serve as a foundational resource for researchers worldwide working in bone and mineral metabolism.



Connecting UK Resources for Agriculture Support

The Cooperative Extension Service, part of the University of Kentucky Martin-Gatton College of Agriculture, Food, and Environment, is designed to extend resources, services, and research-based knowledge to farmers, communities, and families across the state. Working in collaboration with the College and Extension Service, CAAI provides an LLM to help Kentucky's ~300 extension agents and citizens they support find relevant information, navigate the different College of Agriculture websites and databases, and provide answers to questions in a conversational manner.

Leveraging Retrieval-Augmented Generation (RAG) techniques, CAAI can easily create vector datastores from papers, PDFs, webpages, and data sets to retrieve the nearest semantically related and contextually relevant documents for a particular search query. The LLM can then use these records to enhance the prompt by giving it the relevant context needed to answer queries in a fashion that is consistent with the information stored in the vector datastore. The result is a more informed generative response.

Additional experimental projects utilizing RAG techniques include:

- *AI-Aided Diagnostic Tool*: Helping clinicians group individuals based on symptoms and labs, improving triage efficiency
- *Graduate Studies Lookup*: Assisting Directors of Graduate Studies by quickly answering questions with information from the graduate school manual
- *KyStats*: Enabling educators to conversationally explore and gain insights from large educational datasets

Projects

PubMed Literature Agent

Uncovering University of Kentucky Studies that "Meet People Where They Are"

UK is committed to research that embodies the "meet people where they are" healthcare principle, which involves providing empathetic care in settings such as patients' homes, encampments, or other non-traditional environments. To support this principle, UK aims to identify evidence-based literature published by UK researchers that reflects this approach. However, traditional database searches that rely on metadata tags and keyword matching often fall short when addressing nuanced and non-standardized concepts.

CAAI has developed a solution that leverages artificial intelligence agents with LLMs to improve searching the PubMed database. The agent uses tailored prompt engineering to focus an LLM on specific parts of the text, using deep semantic analysis for contextual alignment.

From the initial filtered dataset of 2,997 articles, the model identified 227 studies utilizing non-traditional outreach methods or delivery of healthcare in unconventional locations. By contextualizing research methods within the specified principle, the agent significantly improved the precision of the extracted information, resulting in a more targeted set of results. The inclusion of selection rationale in the standard output allows a top-level view for quicker human evaluation. The deployment of this AI-driven approach has potential to revolutionize literature search practices, particularly in identifying studies that prioritize health equity through non-traditional outreach methods. Furthermore, the methodology can be adapted for broader applications where nuanced contextual understanding is critical for information retrieval.

The Team

CAAI promotes an environment and culture of experimentation, exploration, and career development.

The 37 members of CAAI include high school, undergraduate and graduate students, as well as entry-level and seasoned professionals. Roles within the department include marketing communications, user experience, program and technical management, and software development. CAAI thrives by fostering collaboration between early-career and late-career professionals, creating a dynamic environment where new thinking and seasoned expertise intersect. This blend of diverse skill sets and experience enhances creativity, drives innovation, and increases complex problem solving capabilities while bolstering a culture that mentors and accelerates growth for all. Since 2021, CAAI has supported 8 undergraduate students, 6 high school students, and has 7 staff members currently enrolled in graduate STEM programs.





Cody Bumgardner, PhD

Director, CAAI

Assistant Dean, Artificial Intelligence & Data Science
 UK College of Medicine
 Division Chief for Pathology Informatics Senior Fellow for Innovation
 Kentucky Council On Postsecondary Education (CPE)
 Co-Director of the UK AI in Medicine Alliance

Doctor of Philosophy, Computer Science, University of Kentucky
 Bachelor of Science, Computer Engineering, University of Kentucky

Dr. Cody Bumgardner is the Director of the Center for Applied Artificial Intelligence (CAAI), Division Chief of Pathology Informatics, and Assistant Dean for AI & Data Science in the University of Kentucky College of Medicine. He also directs the Kentucky Regional Optical Network (KyRON), coordinating statewide access to advanced research cyberinfrastructure. With over three decades of experience in technology and research leadership, including prior roles as Director of Enterprise Systems and Development, Chief Technology Architect, and Director of Research Computing, he has led numerous large-scale and international research initiatives.

Since moving into academic medicine in 2017, Dr. Bumgardner has founded and grown the Division of Pathology Informatics, leading development of a fully automated, clinically validated genomic processing pipeline now in routine clinical use at UK Healthcare. He established the Kentucky Pathology Data Trust, aggregating more than 500,000 pathology slides across Kentucky, and has led efforts to modernize research access to electronic medical record data using FHIR standards and reasoning-enabled large language models. He also founded the eICU data repository and automated approaches for clinical time-series forecasting.

Dr. Bumgardner founded CAAI and the University of Kentucky's first CTSA Innovation Core, serves as co-director of the UK CTSA Biomedical Informatics and Data Science (BIDS) program, and was co-director of an AI in Medicine Alliance award. Under his leadership, CAAI has grown to more than 65 active AI projects with participation in over \$80 million in funded grants, spanning multiple departments and external partners. He brings a unique combination of operational leadership, deep technical expertise, and proven experience translating research into clinically validated services, positioning him to lead complex, multi-institutional AI initiatives in biomedical research and healthcare.

DIRECTOR

LEADERSHIP



George Insko

Advisor- AI Security

Masters with Honors, American Military University
Bachelor of Science, University of Kentucky

George Insko is a seasoned cybersecurity executive with more than two decades of experience leading enterprise security, incident response, and digital-forensics operations. His career spans roles as CIO, CISO, and Enterprise Architect, where he has helped organizations navigate complex technological, regulatory, and geopolitical risks. Trained in intelligence and grounded by early academic work in natural resource management, economics, and political science, he brings a multidisciplinary lens to modern security strategy. In recent years, George has led initiatives at the intersection of cybersecurity and artificial intelligence, guiding organizations in the secure adoption of AI, the governance of emerging models, and the integration of intelligent automation into security operations. He is known for building high-performance teams and fostering leadership growth across both technical and operational domains. A practitioner at heart, he combines deep expertise in networking, threat hunting, and incident response with a pragmatic focus on business outcomes and responsible innovation.



Melissa Rowe

Advisor - Technology Industry

Bachelor of Science, Marketing and Finance, Georgetown College
Bachelor of Arts, Fine Arts, University of Kentucky

Melissa Rowe serves as an industry advisor consulting on strategic initiatives and mentoring staff. With 30 years of experience in the technology industry, she has worked for start-ups, mid-sized companies, and large global corporations, including Amazon Web Services, Salesforce, and Dell. She has served in a variety of leadership and individual contributor roles throughout her career, encompassing business development, marketing, strategic planning, and product development. With a career focus on the public sector, she has subject matter expertise in health, human services, unemployment, workforce, and economic development. Melissa's superpower of seeing opportunity and patterns in complexity has enabled her to develop first to market solutions, new businesses, and key partnerships across her career. A fifth generation from Kentucky's Appalachian region, she is passionate about bringing economic and health equity to all people regardless of their geographic location, gender, ethnicity, or socio-economic status.

PROGRAM MANAGEMENT



Caroline Leach

Data Management Specialist

Bachelor of Science, Physics and Astronomy, University of Denver

With a background in physics and experience in start-ups, ed-tech, and the non-profit world, Caroline brings a strong understanding of complex systems and an interdisciplinary perspective. As a Data Management Specialist, she explores how LLMs and computer vision can be leveraged in educational and research applications. She collaborates with researchers, faculty, and engineers to develop AI solutions and contributes to grant writing, database administration, and project management. Currently serving as Program Manager for the NSF-funded NAIRR pilot program, Democratizing AI Training and Access Statewide, Caroline supports capacity-building in AI research and innovation across the state. Highly organized with strong communication skills and educational expertise, she also writes technical documentation and supports promotional and outreach efforts. Pursuing her Master's in Data Science at UK, she is honing expertise in data-driven approaches and advanced AI methodologies. Being part of the CAAI team places her at the intersection of innovation and impact, and she finds it deeply rewarding to help people develop and implement transformative AI technologies.



Emily Collier

Data Management Specialist

Master of Science, Library Science, University of Kentucky
Bachelor of Fine Arts, Art History, School of the Art Institute of Chicago

As the previous Assistant University Archivist, Emily was a key implementor in developing the Web Archiving Program at the University of Kentucky's Special Collections Research Center, establishing policies, workflows, and technical documentation that positioned web-born content as essential institutional records. Now, at CAAI, Emily contributes to the translation of AI into real-world academic and clinical applications by managing high-level operations across a diverse portfolio of interdisciplinary projects. She serves as a primary liaison between faculty, researchers, and technical staff, guiding project intake, scoping, and development while designing strategic frameworks to support ethical, sustainable AI deployment. Her work reflects an enduring interest in how institutions generate, manage, use, and preserve complex data over time. Emily brings a commitment to long-term usability, data integrity, and public benefit, ensuring that as AI reshapes research, its outputs remain meaningful and accessible over time.

COMMUNICATIONS



Kristen Hankins

Project Specialist

Master of Arts, Art History, University of Louisville
Bachelor of Arts, Arts Administration, University of Kentucky

Kristen Hankins is a Project Specialist with an academic foundation in the arts. Kristen earned a Master of Arts in Art History, with a thesis on the impact of André Breton's French Surrealism on American animation and film. Before pursuing graduate studies, Kristen obtained a Bachelor of Arts in Arts Administration, complemented by minors in Art History and Music Theory/History. This multidisciplinary education allows the development of a comprehensive understanding of curation and management skills that are transferable within all fields. As a Project Specialist, Kristen excels in facilitating effective communication within complex experimental initiatives, navigating uncertainties, understanding the dynamic needs of each project, and cultivating a collaborative environment that drives ingenuity.



Harrison Whaley

Content Strategist

Harrison is passionate about serving people through technology and media. He draws upon his experiences as a business owner of his company ThePhaseTwo Media to approach problems from various angles. Harrison aims to deliver content that yields results. Photography and videography are specializations of his. From weddings to real estate, Harrison has captured it all. CAAI's successful media presence can be attributed to Harrison's efforts. He has collected many hours of footage for tutorial videos of CAAI's tools. Working directly with software developers and the general public, he showcases the work CAAI develops clearly and unambiguously. Harrison continuously brings fresh ideas to the table and has a keen eye for detail.

ENGINEERING & DATA SCIENCE



Samuel Armstrong

Senior Software Engineer, Technical Lead

Master of Science, Computer Science, University of Kentucky
Bachelor of Science, Computer Science, University of Kentucky

Samuel is the Technical Lead for the CAAI and a part-time Ph.D. student in Computer Science. Since the center's inception in 2023, he has been actively involved in nearly every project, contributing to advancements in AI applications within healthcare. He began as an undergraduate intern at the Institute for Biomedical Informatics (IBI) under Dr. Cody Bumgardner. His early work focused on genomic data analysis and developing text-to-speech and audio-to-text applications. After graduating, he transitioned to a staff position as a programmer, where he played a critical role in research projects exploring the application of AI in medicine. When the Center was launched, Samuel was promoted to Technical Lead. In this role, he directs the a team of developers and interns, contributing directly to the success of the Center's projects and advancing the application of AI across Kentucky. Samuel's research focuses on the intersection of AI and healthcare.



Aaron Mullen

Software Developer

Bachelor of Science, Computer Science, University of Kentucky

Aaron began working in the department that would become CAAI as an undergraduate intern. He worked throughout his junior and senior year until becoming a full-time staff member upon graduation. He is now pursuing a Master of Science in Data Science. Throughout his time at CAAI, he has worked in a variety of fields, such as website development, machine learning, and data visualization. He specializes in and has worked on projects in data science and machine learning methods like classification and time series forecasting. He has contributed to multiple CAAI projects, such as CLASSify, an online tool for easily performing machine learning classification and data analysis. He also works with the Rapid Actionable Data for Opioid Response in Kentucky (RADOR-KY) team to build forecasting models to predict future opioid overdose trends for different areas of the state of Kentucky.

ENGINEERING & DATA SCIENCE



Vaiden Logan

Software Developer

Bachelor of Science, Computer Science, University of Kentucky

Vaiden is a Computer Engineering graduate from the University of Kentucky, currently pursuing a Master of Science in Computer Science. He focuses on LLMs, the DGX computing cluster, CAT-Talk, and LLM Factory. Previously, Vaiden worked on the FABRIC project in the Computer Science department, where he contributed to setting up a Named-Data Networking (NDN) network to move high-energy physics data. Vaiden's expertise lies in computer networking and he has extensive experience collaborating with computer scientists and data scientists. He is currently focused on leveraging LLMs for summarization tasks and designing systems that integrate AI for a variety of applications.



Noah Perry

Web Developer

Bachelor of Science, Computer Science, University of Kentucky

Noah has a background in software development, web service management, and data science. He is currently pursuing a doctoral degree in Computer Science. At UK he studied covering a range of material from algorithm design, web and UI/UX design, and more. He works for the CAAI working primarily on website development and data science. Noah works with the Endless Forms group to work on establishing accessible medical standards for explanatory graphics through the Graphic Design Ontology and graphics compiled using its standards. He also works in data analysis with the All of Us Research Program and with UK Hospital in analyzing quality care metrics and patient care outcomes. Additionally, he works with the REDCap data capture platform to expand its capability, integrate CAAI platform software with the application, and assist others in using the platform.

ENGINEERING & DATA SCIENCE



Mitchell Klusty

Software Developer

Bachelor of Science, Computer Science, University of Kentucky

Mitchell is currently pursuing a Master of Science in Computer Science. While completing his Bachelor of Science, Mitchell earned a Cybersecurity certificate from UK, thus gaining a strong foundation in secure systems design and analysis. As a software developer at CAAI, Mitchell's knowledge of security is imperative to the operations of the department. In addition to cybersecurity, he continues to specialize in the development and application of Large Language Models (LLMs). He is the designer and lead developer of LLM Factory, CAAI's innovative self-service LLM tool that empowers researchers and university members to leverage AI solutions efficiently. Mitchell's passion for LLMs and his expertise in cybersecurity add value to CAAI.



Evan Damron

Software Developer

Bachelor of Science, Computer Science, University of Kentucky

Evan is from Lexington, KY and started at CAAI as an undergraduate intern with over a year of prior research experience. After completing his bachelor's degree in computer science, he transitioned into a staff role and is now pursuing his master's degree. His primary focus is embodied AI, with the goal of enabling autonomous robots to engage in human-like interaction, especially in healthcare settings. By combining the conversational and reasoning abilities of large language models with conventional deterministic robotics approaches, Evan has significantly expanded the capabilities of the Temi robot. His work is helping to shape a future where robots contribute to providing more accessible, cost-effective healthcare without compromising quality.

ENGINEERING & DATA SCIENCE



Caylin Hickey

Cloud Engineer

Bachelor of Science, Computer Science, University of Kentucky

Caylin started working for UK as a student in late 2011 documenting websites for the College of Nursing and later as an intern for the UK IT Enterprise Architects team. Upon his graduation in 2013, he began working for UK IT full time. In late 2015 his group was approached to help automate genomics processing for UK Healthcare running private, proprietary pipelines. This became clinically functional over the following years and in 2017 he transitioned to UK Healthcare, first on a grant for the Department of Pathology and later as an employee of the Clinical Lab. He has started and assisted with several projects related to genomics, digital pathology, clinical laboratory methods, tracking systems, and routine data manipulation. He started working with CAAI helping with management of the DGX cluster and other various *nix system administration troubleshooting. He is a motivated problem solver, taking on projects to refine and improve functionality or expand features.



Mahmut Gokmen

Software Engineer

Master of Science, Computer Science, University of Kentucky
Bachelor of Science, Computer Science, University of Kentucky

Mahmut Gokmen is currently a PhD student at UK. His role primarily involves finding solutions to challenges in the medical imaging domain using deep learning techniques and AI models. Currently, he is working on vision models, which allows him to apply various image processing and analysis techniques across different domains, including CT scans, pathology, and MRI. His main contribution lies in bridging and integrating these diverse research areas with the latest advancements in machine learning and AI to produce meaningful and impactful results. His career began with microchip programming skills after graduating from university. He worked in research and development departments in the industry, and a few years later, decided to become a research assistant in Turkey to advance his research interests. Now, he is studying for his doctoral degree at UK. He excels at understanding and designing deep neural networks and AI models and dedicated an entire year to analyzing and designing AI models without any distractions, significantly enhancing his expertise.

Previous Team Members



Jeffery Talbert

Director, Institute of Biomedical Informatics

Doctor of Philosophy, Texas A & M University
 Master of Arts, Texas A & M University
 Bachelor of Science, Texas A & M University

Dr. Talbert was Professor and Division Chief in Biomedical Informatics at the UK College of Medicine. He is the Director of the Institute for Biomedical Informatics, a campus-wide interdisciplinary home for biomedical informatics across the University. Anointed in 2014 as Associate Director of the UK Center for Clinical and Translational Science (CCTS) and was the Deputy Director of the Center for Rural and Underserved Health Research. His research specialization is public health informatics focused on the intersection of evidence-based policy and health care outcomes. Current research projects focus on big data approaches to reducing substance use disorder and designing analytic approaches to improve health outcomes for state Medicaid programs. He has over 30 years of experience in health research, including serving as a research fellow for the US Congress, as a faculty member in Public Policy, Public Health, Pharmacy, and Medicine. He is currently Professor and Department Chair in AI and Health and Georgia Research Alliance Eminent Scholar at the Medical College of Georgia, Augusta University.



Kenneth Calvert

Research & Industry Advisor

Doctor of Philosophy, Computer Sciences, University of Texas at Austin
 Master of Science, Computer Science, Stanford University
 Bachelor of Science, Computer Science and Engineering, Massachusetts Institute of Technology

Dr. Calvert is a distinguished computer scientist with a strong foundation in both academia and industry. He currently serves as an Advisor at CAAI, consulting on strategic initiatives and mentoring staff. From 1979 to 1984, Dr. Calvert was a member of Technical Staff at Bell Laboratories in Holmdel, New Jersey. He served as a faculty member in the College of Computing at Georgia Tech from 1991 to 1998. In 1998, he joined the UK faculty, where he became Department Chairperson in 2007. Recognized for his contributions to the field, Calvert was named a Fellow of the Institute of Electrical and Electronics Engineers in 2012. From 2016 through 2019, Dr. Calvert served at the National Science Foundation in the position of Division Director for the Division of Computer and Network Systems, in the Directorate for Computer and Information Science and Engineering. In that capacity he was responsible for a \$230M annual research budget, including research programs in Networking, Computer Systems, Secure and Trustworthy Cyberspace, Cyber-Physical Systems, Smart and Connected Communities, Education and Workforce Development, and other priorities.

Previous Team Members



Caner Özcan

Advisor - Visiting Professor

Doctor of Philosophy, Computer Engineering, Karabük University
Bachelor of Science, Computer Engineering,
Yıldız Technical University

Dr. Caner Özcan was born in Karabük in 1986 and completed his primary, secondary and high school education in the same city. In 2008, he graduated from Yıldız Technical University, Department of Computer Engineering. In 2015, he completed his PhD studies and began as a faculty member at Karabük University, Department of Computer Engineering in January 2016. In 2017, with the support of TÜBİTAK, he worked as a visiting professor at Purdue University in the USA for 10 months. His main research interests include image processing, machine learning, deep learning and remote sensing. He is a field editor in Jestech journal and a referee in many field journals and projects. Within the scope of Deneyap Technology Workshops, he prepared Software Technologies course contents and books for middle/high school students. In 2020, he received TÜBİTAK BIGG Entrepreneurship support and founded the AI company SimurgAI in Karabük University Technopark. September 2023, he worked as the Coordinator of Karabük University Scientific Research Projects Coordination Unit for 10 months. He continues to work as a faculty member at Karabük University Software Engineering Department.



Matthew Mosely

Systems Professional

Foreign Service Institute,
U.S. Department of State
United States Navy

Matthew's primary interest is aiding others to push the boundaries of AI in healthcare. He assisted with providing the resources and tools that researchers need by leveraging advanced technologies in AI and computation in general. In previous roles at UK, he oversaw the infrastructure used by the Center for Computational Sciences for 8 years and was a part of the Information Technology Services Network group for 3 years. Prior to UK, he was a Systems Integrator for the U.S. Department of State (DoS) and was responsible for upgrading the computer networks at U.S. Embassies and Consulates around the world as part of the Global IT Modernization project (GITM). GITM locations included: Moscow, Baghdad, Ciudad Juarez, Budapest, Matamoros, Kolonia, Majuro, and Kabul. Matthew served in the Navy prior to DoS where he trained as an Electronics Technician specializing in communications systems and later cross trained as an Information Systems Technician before honorably finishing his 6-year commitment.



Doyle Friskney

May 17, 1947 - July 26, 2025

Academic Technology Advisor

Doctor of Education, Educational Leadership, Morehead State University

Master of Education, Educational Administration, Xavier University

Bachelor of Arts, Education, Thomas Moore College

Bachelor of Science, Education, Cincinnati Bible Seminary

Doyle Nelson Friskney, PhD was leader in educational technology at the UK with a distinguished career spanning over 30 years. Dr. Friskney earned his undergraduate degree from Cincinnati Bible College, a graduate degree from Xavier, and a Doctor of Education from Morehead State University. His career began as a youth pastor, then moved to the University of Kentucky to serve in multiple leadership roles over three decades, including Chief Technology Officer and Director of Communications and Network Systems.

He was instrumental in building the university's digital infrastructure and created Lexington's first computer camp, introducing technology to thousands of students. As an administrator at UK, he oversaw critical initiatives such as designing advanced learning spaces, implementing statewide higher education networks, and integrating technology into the academic and administrative systems. In addition to his administrative leadership, Dr. Friskney was an adjunct faculty member in the College of Communication and Information, where he taught courses in leadership and entrepreneurship.

Finally, he served as a Senior Fellow at the Kentucky Center for Postsecondary Education and as an Academic Technology Advisor at CAAI, advising on strategic initiatives and mentoring staff and interns alike. Dr. Friskney was passionate about advancing access to quality education and fostering innovation in higher education. He advocated for the ethical and transformative use of artificial intelligence in education and enjoyed collaborating across disciplines to create transformative educational experiences. He was dedicated to lifelong learning and exploring new applications of AI to revolutionize teaching and research.

In Memoriam

Thank You

Center for Applied Artificial Intelligence
University of Kentucky
Healthy Kentucky Research Building, Suite 360



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ai@uky.edu



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