

# **Tennessee Tech University: Action Plan for Artificial Intelligence Education, Workforce Development, Research, and Infrastructure Needs**

Response to the Request for Information (RFI) on the Development of an AI Action Plan

Submitted to: The Networking and Information Technology Research and Development (NITRD) National Coordination Office

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## EXECUTIVE SUMMARY

Tennessee Tech University (TnTech) submits this response to the National Science Foundation's (NSF) Request for Information on the Development of Artificial Intelligence (AI) with a focus on education, workforce development, and research. Recognizing the transformative impact of AI, we propose targeted initiatives to bolster the nation's AI workforce and research capabilities, emphasizing interdisciplinary collaboration, real-world application, and responsible AI innovation.

To strengthen the AI workforce, we recommend the following initiatives:

- **Scholarship for Service Program for AI:** Modeled after successful CyberCorps programs, a dedicated scholarship program would incentivize AI education and service commitments.
- **Industry and Government-Endorsed AI Certificates:** Establishing a certification framework ensures workforce readiness and alignment with industry needs.
- **AI-Integrated Education:** Transforming education in every field by integrating AI to enhance problem-solving and adaptability.
- **Academia-Industry Collaboration:** Encouraging stronger ties between academic institutions and the private sector to facilitate experiential learning opportunities.

To strengthen and enhance national research priorities, we recommend the following:

- **Responsible and Trustworthy AI:** Government-backed incentives should promote research in AI fairness, transparency, and security, ensuring ethical AI deployment.
- **AI for Critical Infrastructure:** Advancing AI applications in cybersecurity, emergency services, energy, agriculture, healthcare, manufacturing, and water management is essential for national resilience and economic growth.
- **Exploration and Application of Recent Advances:** The utility of large language models and foundation models is yet to be understood broadly. Numerous transformative applications are likely still undiscovered. Funding and governance should encourage rapid but safe development of applications that utilize these recently developed methods to competitively advantage the nation.

TnTech's initiatives align with the nation's goals of advancing AI education and research while addressing critical workforce shortages. By supporting AI-Corps, rural AI education, workforce certification, and responsible AI research, we contribute to a robust AI ecosystem that serves the nation's needs. TnTech's interdisciplinary research teams are leading efforts in AI fairness, uncertainty quantification, secure AI, and applied AI solutions for critical infrastructure.

## **INTRODUCTION**

Artificial Intelligence (AI) has been acknowledged as being of strategic importance to the nation's future economy and security. With the rapid adoption and integration of AI throughout our lives at work and beyond coupled with the global competition for AI supremacy, it is vital that the US government work with academia and industry to establish priorities, policies, and programs to continue and expand the track record of American success in advancing AI and to further secure our position as a leader in AI innovation.

The rapid advancement of artificial intelligence (AI) is transforming industries, national security, and economic competitiveness, necessitating a strategic investment in AI education and workforce development, research, and high-performance computing (HPC) infrastructure. To maintain leadership in this critical domain, there is an urgent need to cultivate a highly skilled workforce by integrating AI-focused curricula, hands-on training, and interdisciplinary research opportunities, particularly for educationally and economically disadvantaged populations. Additionally, advancing AI research requires access to cutting-edge computational resources, robust data infrastructure, and collaboration across academia, industry, and government. Strengthening HPC capabilities is essential to support complex AI models, enhance simulation and analytics, and accelerate innovation. This response to the RFI addresses Tennessee Tech's capabilities for establishing "U.S. policy for sustaining and enhancing America's AI dominance" through best practices and opportunities in AI education, research, and infrastructure development to inform policies and investments that will drive sustained progress in AI and its applications throughout the nation, starting in Tennessee and the South.

## **EDUCATION AND WORKFORCE DEVELOPMENT**

To strengthen our nation's AI workforce, we suggest four policies/initiatives:

- 1. Implement a Scholarship for Service program for AI;**
- 2. Encourage the development of industry and government-endorsed AI certificates;**
- 3. Support interdisciplinary AI education efforts; and**
- 4. Incentivize more interaction between academia and industry.**

**In support of these initiatives**, TnTech has started implementing several key educational and workforce development programs.

### **AI-Corps**

Starting in the Fall of 2023, TnTech began piloting an AI-Corps program focusing on workforce development in Artificial Intelligence by enhancing the educational, service, and research experiences of undergraduate and graduate students. This program is informed by TnTech's

highly successful CyberCorps SFS program (<https://www.tntech.edu/ceroc/education/sfs/>) and seeks to enhance both the curricula for TnTech's CS concentration in Data Science and Artificial Intelligence (DSAI) and provide additional experiential learning outside of the classroom.

With the goal of increasing the number of qualified students entering the artificial intelligence workforce, the objectives of the TnTech AI-Corps program are to:

1. Expand and improve the campus's learning experiences in artificial intelligence;
2. Enhance AI-Corps scholars' knowledge and skills through a program that values participation in education, research, and service;
3. Provide AI-Corps scholars with real-world experiences through summer internships; and
4. Assess the performance of an SFS-like program that integrates education, research, and service in artificial intelligence.

A key component of an effective artificial intelligence program that can produce ready-to-work graduates is a continuous sustainable culture to engage students in hands-on AI practices outside of the classroom. AI-Corps scholars work with a faculty mentor to develop an annual professional development plan that is reviewed periodically throughout the year, including such things as anticipated courses, research plans, and service activities.

Under the auspices of TnTech's new Machine Intelligence and Data Science (MInDS) Center [[www.tntech.edu/minds](http://www.tntech.edu/minds)], with the financial support of TnTech and the Cybersecurity Education Research and Outreach Center (CEROC) (<https://www.tntech.edu/ceroc/>), this pilot program currently supports 3 undergraduate students and 1 graduate student, and all of the AI-Corps students have:

- ✓ Organized and participated in multiple outreach events, including introducing AI to students from multiple high schools and hosting hackathons;
- ✓ Participated in a group artificial intelligence research project;
- ✓ Attended an AI conference where they were able to meet leading researchers in the field, and
- ✓ Procured summer internships in the field of AI at four different major corporations in the U.S.

Our goal for this pilot is to provide a proof of concept that demonstrates the effectiveness of an AI workforce development strategy and a supporting infrastructure that is informed by our existing cybersecurity workforce development programs. The AI-Corps scholars are already showing a level of experience and maturity that will position them well in the AI workforce. We feel that this pilot, coupled with our CyberCorps and DoD Cyber Service Academy (CSA) track record, uniquely establishes Tennessee Tech as being at the forefront of AI workforce development and future scholarship for service programs. We believe that expanding similar programs throughout the region and the nation can help to create a workforce capable of sustaining and enhancing America's AI dominance.

## **AI and Data Science Education and Workforce Development in Rural Communities**

The existing landscape of AI workforce development faces significant challenges and gaps that hinder its capacity to meet the demands of a rapidly evolving digital economy. One prominent challenge is the shortage of individuals with specialized skills in AI, including proficiency in programming languages, statistical analysis, and machine learning algorithms [1]. This shortage is exacerbated by the fact that the field of AI is constantly evolving, necessitating ongoing training to keep pace with technological advancements and emerging best practices [2]. Bridging these gaps requires collaborative efforts among educational institutions, industry stakeholders, and policymakers to facilitate lifelong learning opportunities for AI professionals [3]. We are proposing an approach that will demonstrate an AI workforce development approach that bridges some of the gaps between academia and rural communities.

Rural regions often benefit from community-academic partnerships. Tennessee Tech (TnTech) is located in the rural Upper Cumberland region, where one county is considered economically distressed, six are considered economically at-risk, and in contiguous counties, there are three more distressed counties. Currently, TnTech is involved in a Grand Challenge called Rural Reimagined, whose purpose is to transform rural living through harnessing science, technology, and economic development (<https://www.tntech.edu/grand-challenge/>). The overall goal of this program is to establish a project-based framework that improves both the recruitment of students into AI as a career as well as the education of students and rural communities about the potential benefits of AI. The main objectives of this program involve the following:

1. Establish sustainable community-academic partnerships that provide students access to relevant, real-world AI projects that will assess the AI readiness of both students and rural organizations.
2. Develop reproducible curricula, modules, and assessment tools that improve AI workforce development by providing students with foundational AI knowledge regardless of their field of study.
3. Diversify the experiences of students from underserved rural communities through the incorporation of real-world, locally impactful projects across multiple disciplines and high schools.

Our approach provides an educational framework, including courses, modules, and projects, and their benefit to the students and the rural community. We assess our approach to learning AI and the overall impact of providing an AI workforce ready to tackle problems in rural communities.

## **Data Science and Artificial Intelligence Career Readiness Certificate**

The growing demand for expertise in data science and artificial intelligence (AI) across industries underscores the need for a specialized certificate program that equips students of all backgrounds with essential skills in this rapidly evolving field. As organizations increasingly rely on data-driven decision-making and AI-powered solutions, there is a critical shortage of qualified individuals who can develop, implement, and ethically manage these technologies. A

certificate program in data science and AI can provide structured, hands-on training in key areas such as machine learning, data analytics, and computational modeling, ensuring that participants gain both theoretical knowledge and practical experience. This certificate will be particularly valuable for individuals seeking to enhance their current expertise to meet workforce demands. By offering a focused curriculum tailored to industry needs, this certificate will help bridge the skills gap and create a pipeline of talent ready to tackle real-world challenges in AI and data science.

Currently, TnTech employs a Gold and Purple Career Readiness Certificate, based mostly on the National Association of Colleges and Employers (NACE) Career Competencies, for both underclassmen and upperclassmen. The program is designed to help students identify where their skills are being developed and how to better communicate those skills to employers. This semester, TnTech is rolling out a Data Science and Artificial Intelligence Career Readiness certificate that requires a student to complete tasks in 4 areas:

- ✓ Data Science Skill Building
- ✓ Artificial Intelligence Skill Building
- ✓ Field Experience in AI and Data Science
- ✓ Extramural Activities in AI and Data Science

To further support the efficacy of this certificate, as well as other certificates in artificial intelligence across this nation, there need to be government and/or industry-managed accreditation mechanisms that will allow for easy and fast approvals of certificates. Doing so will make it easier for institutions to be on the forefront of educating the next generation of AI workforce development.

### **Graduate CS Education to Align Soft and Technical Skill Development with Industry AI Workforce Needs**

Graduate computer science students today face a myriad of challenges as they prepare to enter the workforce, particularly in an industry characterized by rapid technological advancements and evolving skill requirements. One notable challenge lies in the ever-widening gap between the theoretical knowledge imparted in academic programs and the practical skills that employers demand. This disconnection often results in graduates lacking the necessary storytelling experience and industry-specific competencies, leaving them ill-equipped to navigate real-world scenarios effectively [4]. Additionally, the fast-paced nature of the field necessitates continuous learning and adaptation, as well as a demand for interdisciplinary skills, such as communication and teamwork [5]. Addressing these challenges requires a holistic approach that integrates practical experiences, fosters collaboration between academia and industry, and emphasizes developing industry-relevant technical and soft skills among graduate students.

A typical graduate computer science education consists of courses, seminars, projects, and/or research. The majority of Master's degree graduates in computer science do not continue in academia, opting instead to go into industry [6]. However, most institutions provide a more

research-focused education, in which topics and material are aligned with faculty research agendas, are more theoretical, or focus purely on technical skills. For this effort, TnTech is developing an industry-focused, real-world use-inspired project experience in artificial intelligence, with a focus on teamwork and soft skills, with the goal of producing candidates who are more workforce-ready. With the guidance of industry and communication educators, we are leveraging an existing industry engagement with our undergraduate program capstone course and piloting a new Master's level concentration that provides practical and industry-relevant AI learning experiences. The main objectives of this program are:

1. Creating a new graduate-level course in Professionalism in Artificial Intelligence for Industry. This new graduate-level course introduces students to soft skills including teamwork, communication, and mentoring, as well as project management and ethics as it pertains to AI project work.
2. Modifying the Project Component of the non-thesis option exposes students to more soft and technical skills opportunities. This provides the student with AI expertise, as well as experience acting as mentors to undergraduate students on their senior capstone project.
3. Adding more soft skills experiences to existing AI courses. In addition to the new course and working on undergraduate capstone teams, students in this concentration are required to continue to work on their communication skills as part of other activities.

## RESEARCH

Regarding research, we suggest the following two policies/programs:

1. **Incentivize the development of techniques that promote and support responsible and trustworthy AI, including large language models and other generative AI;**
2. **Promote innovation at the intersection of AI and critical infrastructure;** and
3. Fund and govern the safe development of applications that utilize recently developed AI methods to competitively advantage the nation

Researchers at Tennessee Tech are working in all of these areas.

### **Responsible and Trustworthy AI**

We need a solid understanding of what it means for AI to be both responsible and trustworthy and how those aspects impact human-AI interaction. Researchers at Tennessee Tech work in at least four areas related to this area: eXplainable AI (XAI), uncertainty quantification (UQ) for machine learning models, model fairness, and secure AI.

A shared understanding of the importance of responsible and trustworthy AI is vital to the adoption of AI, especially in areas of critical infrastructure. Furthermore, we need a robust set of tools and techniques to assess AI along these two dimensions and to enable improvements in these areas.

We have multiple efforts in these important areas, including the following:

- Understanding the impact of model fairness and explainability on model trust in healthcare,
- Supporting secure and autonomous vehicle operations in a zero-trust environment,
- Understanding the role of UQ in determining where a model is strong or weak,
- Developing a model for improving policies related to the management of complex machine learning models,
- Understanding and mitigating model trust issues caused by model compression, and
- Developing models for responsible use of generative AI in fields such as software development.

It is important for the government to define issues of responsible and trustworthy AI as national priorities and allocate funding to support work in these areas.

### **Interdisciplinary research combining AI and critical infrastructure**

Developing safe, impactful, and novel ways to apply AI to support critical infrastructure is of vital importance to our nation. Such applications could improve this infrastructure through improving its security, providing additional insight into its design and operation, and improving its efficiency and effectiveness.

Numerous researchers at Tennessee Tech are actively pursuing innovative applications of AI to support critical infrastructure.

- **Cybersecurity**: Cybersecurity continues to be a critical component for the safety and security of both public and private sector assets. AI is key to the effectiveness of cybersecurity. This is a large and active area of work among faculty in both our Machine Intelligence and Data Science (MInDS) Center and our Cybersecurity Education, Research, and Outreach Center (CEROC).
- **Emergency Services**: Time-critical decision-making is a challenge continually faced by emergency service personnel. Investing in how to best bring AI-driven decision support in such environments is an important and challenging task. In research funded by NIH, we are looking at helping first responders make more accurate decisions through the use of trustworthy machine learning tools.
- **Energy**: From smart grids to electric vehicles to power grid security, AI has rapidly become a vital component of the power infrastructure that our country depends on. University researchers are pursuing multiple projects at the intersection of AI and energy systems. Through our Center for Energy Systems Research (CESR), we have done significant work in smart grid research. Additionally, we have recently received funding from NSF for an NSF Research Traineeship (NRT) grant for graduate students working to combine energy, AI, and cybersecurity.
- **Food and Agriculture**: Intelligent monitoring and management of crops can increase the availability of food, improve its quality, and decrease its cost. At Tennessee Tech, agriculture faculty are partnering with CS faculty to work in the area of smart farming.

- **Healthcare**: Skyrocketing costs and the ever-increasing complexity of healthcare and healthcare delivery necessitate the adoption of AI to support healthcare providers. Researchers across campus are working on projects like applying AI to develop better joint replacements and studying how to apply AI to provide just-in-adaptive decision support for college students struggling with anxiety and depression.
- **Manufacturing**: Manufacturing is another area that is benefiting greatly from the application of AI to improve its processes. Multiple researchers in our College of Engineering are working through our Center for Manufacturing Research (CMR) to advance the field of smart manufacturing, including efforts to make it more secure, more automated, and more efficient and effective.
- **Water**: Additionally, the management of water, both in support of human life and in protecting humans from disasters such as floods, can benefit from the use of AI. Faculty in our Center for the Management, Utilization, and Protection of Water Resources are working to apply AI to better manage and monitor water by applying machine learning to challenging problems such as flood prediction.
- **Practical and Impactful LLM Applications**: A research team focuses on understanding and applying large language models. In concert with researchers at the University of North Carolina in Asheville, the team is studying the application of LLMs to the preservation of the Cherokee language. They are developing LLM-based adaptive assistants through game environments. Finally, they are developing an LLM browser extension to make the internet more accessible to those affected by the digital divide. In addition to these efforts, they are working to fundamentally understand the cognition of LLMs. The team's overarching belief is that the broad utility of LLMs is still largely unrealized, and they hope to change that.

## ARTIFICIAL INTELLIGENCE INFRASTRUCTURE

Investing in research and development programs to enhance high-performance computing (HPC) support for AI is essential. While efforts in this area existed prior to the establishment of Tennessee Tech's Advanced Scalable Computing, Extreme Networks & Data (ASCEND) Center, the Center is significantly amplifying and advancing these initiatives. ASCEND is addressing critical challenges in HPC by conducting cutting-edge research in scalable systems and network architectures tailored for AI workloads.

- **Better Algorithms for AI**: HPC research at the boundaries of energy, efficiency, programming models, new architectures, and better algorithms for AI are essential to the national interest.
- **Open Science**: While resources at the Exascale level will be invested in nationally by NSF, DOE, and others to support open science, resources at multi-Petascale at regional and state levels are also needed with research in computer science, systems, algorithms, and methods to enhance AI emphasized, rather than just production applications based on AI.
- **Multidisciplinary Research**: Multidisciplinary research in advanced computer architectures that go beyond exascale and go beyond current CPU+GPU models is

needed. These investments in design and prototyping, likely in conjunction with NSF, DOE, and DOD, are needed to drive beyond Exascale and to begin to pay attention to the extreme energy costs of AI currently.

- **Investments in Testbeds**: Investments in AI that bridge HPC/Supercomputer with Cloud, Edge, and AI are important to enabling optimization of the use of AI in contexts relevant to people, critical infrastructure protection, and experimental automation. These investments should include regional and local testbeds.
- **Access to HPC and Cloud**: In order to support the combined goals of workforce development, education, research, and outreach, it is important for there to be broad access to significant AI resources at the HPC and Cloud level across institutions of higher learning. These have to be free or inexpensive to use and access in order to enable deep and broad use in classrooms and other training and learning contexts.
- **Hardware Standards**: The current dominance of a few vendors (e.g., NVIDIA) in the AI hardware space has displaced important standards for scalable computing and programming with vendor-specific approaches. Investments in national and international standards that transcend vendors and vendor-lock will be important to achieving performance portable, open science applications, and open-source software of enduring value to drive modeling and simulation infused with AI, as well as AI applications that are stand-alone.

ASCEND is exploring AI-assisted programming techniques to optimize parallel computing, ultimately improving efficiency and performance. By fostering innovation at the intersection of AI and HPC, ASCEND is positioning Tennessee Tech as a leader in this rapidly evolving field.

## **TENNESSEE TECH UNIVERSITY - BACKGROUND**

Tennessee Technological University (Tennessee Tech), located in Cookeville, Tennessee, is a leader in engineering and technology education. Within the university, the MInDS Center is the primary leader driving campus-wide innovation in artificial intelligence (AI).

Tennessee Tech has established itself as a hub for AI initiatives through its commitment to cutting-edge research, investment in state-of-the-art infrastructure, and strong partnerships with government and industry. The university's research programs and facilities provide an ideal environment for groundbreaking work in AI, machine learning, and computational sciences. This includes the Machine Intelligence and Data Science (MInDS) Center.

Tennessee Tech plays a vital role in workforce development, equipping graduates with the expertise needed to address industry demands in AI. The university fosters strong collaborations with federal agencies, defense organizations, and private-sector technology leaders to ensure that its research aligns with national and global priorities.

- **Industry Partnerships**: Tennessee Tech collaborates with key industry stakeholders, offering opportunities for research commercialization, internships, and cooperative projects that provide students and researchers with valuable industry experience.

- **Research Computing Infrastructure:** The university’s High-Performance Computing facility includes advanced computational clusters such as Impulse and Warp 1. These resources support a wide range of research initiatives in AI, computational biology, and data-driven engineering applications.

With its strong use-inspired research foundation, advanced computing infrastructure, and deep connections with industry and government agencies, Tennessee Tech is well-positioned to be a national leader in AI initiatives. The university’s commitment to interdisciplinary collaboration and workforce development ensures that it remains at the forefront of AI advancements, driving innovation and shaping the future of intelligent computing systems.

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