AI Tennessee Initiative

Vasileios Maroulas

Assistant Vice Chancellor for Research
Deputy Director of AI Tennessee Initiative
Professor of Mathematics, Statistics, and Data Science and Engineering

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

Email: vasileios.maroulas@utk.edu

AI **TENN**essee Initiative

***T**ransdisciplinary*
***E**ducation & i**NN**ovation*

Vision

Tennessee rises as a central leader in the global data economy

Goals

- Harness Tennessee's unique strengths and opportunities.
- Propel cutting-edge research across disciplines.
- Equip Tennessee's students for present and future AI-driven careers.
- Forge strategic partnerships with statewide industry, organizations, and institutions.

AI Tennessee Initiative: *Strategic Pillars*

- Research
- Education
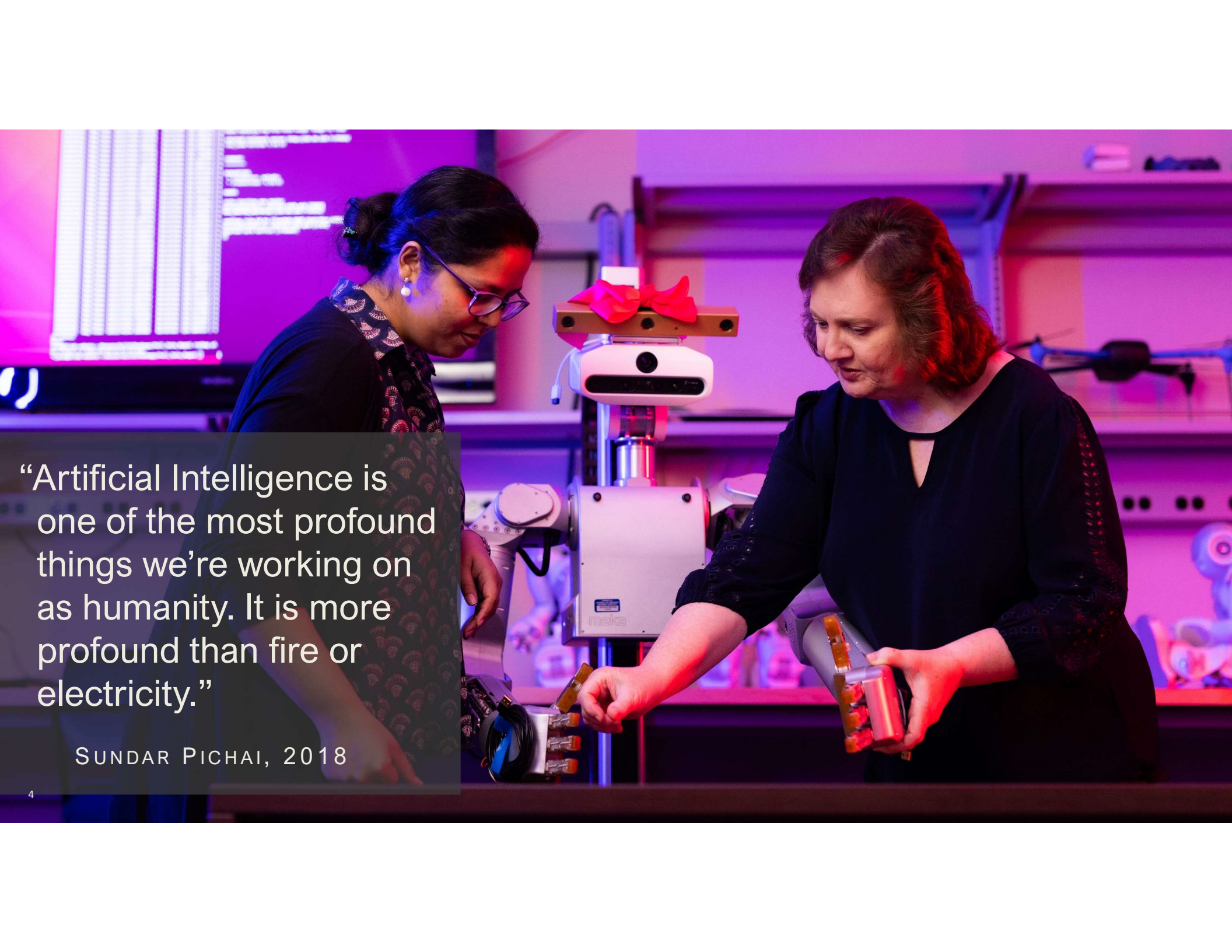- Infrastructure
- Partnerships
- Outreach & Engagement

Why does AI matter?
Why Tennessee?
Why Now?

"Artificial Intelligence is one of the most profound things we're working on as humanity. It is more profound than fire or electricity."

SUNDAR PICHAI, 2018

4

AI will disrupt nearly every industry and state in the US; Tennessee can act early to leverage this transformation

AI technologies are already disrupting industries in unexpected ways…

Nissan's New Aero-Focused AI Design Tool Delivers Results In Seconds Instead Of Days

After some trial and error, Nissan created artificial intelligence that can rapidly predict aerodynamic performance of new designs

by Michael Gauthier   June 15, 2023 at 07:31   6

…and the level of opportunity and disruption to come is enormous

$1.8 Trillion Dollars
Forecasted U.S. market size of artificial intelligence in 2030[1]

Over 500,000 jobs in TN
are expected to be augmented or replaced by AI[2]

Every state and industry will have to engage with AI; Tennessee has an opportunity to leverage, rather than react to, this new technology, in order to **capture outsized impact** and **prepare our workforce**

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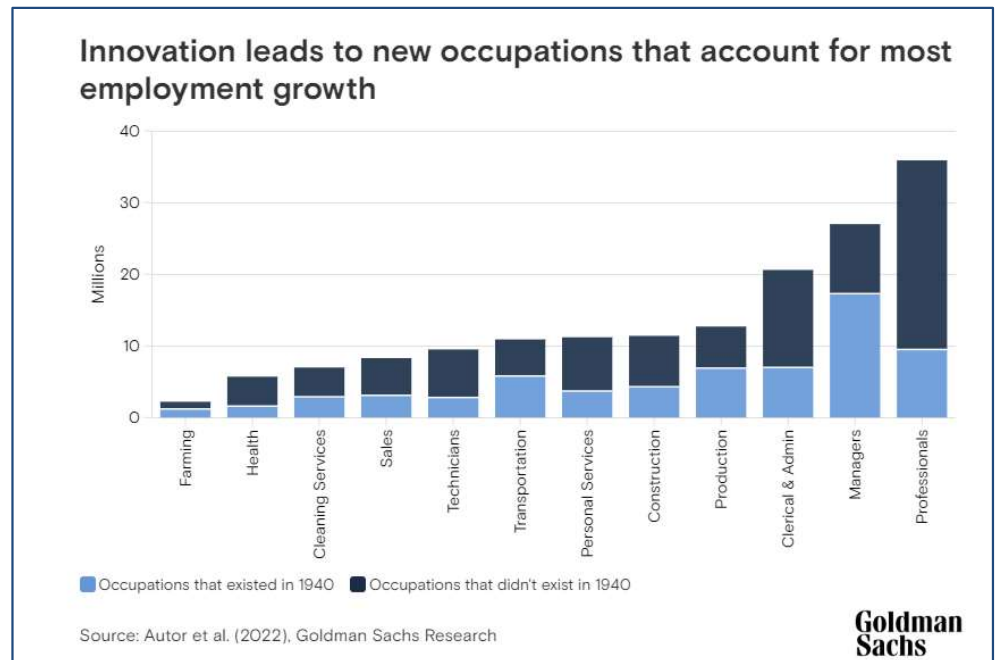# AI is impacting and transforming the workplace

2/3

Fraction of U.S. occupations that could be partially automated by AI

60%

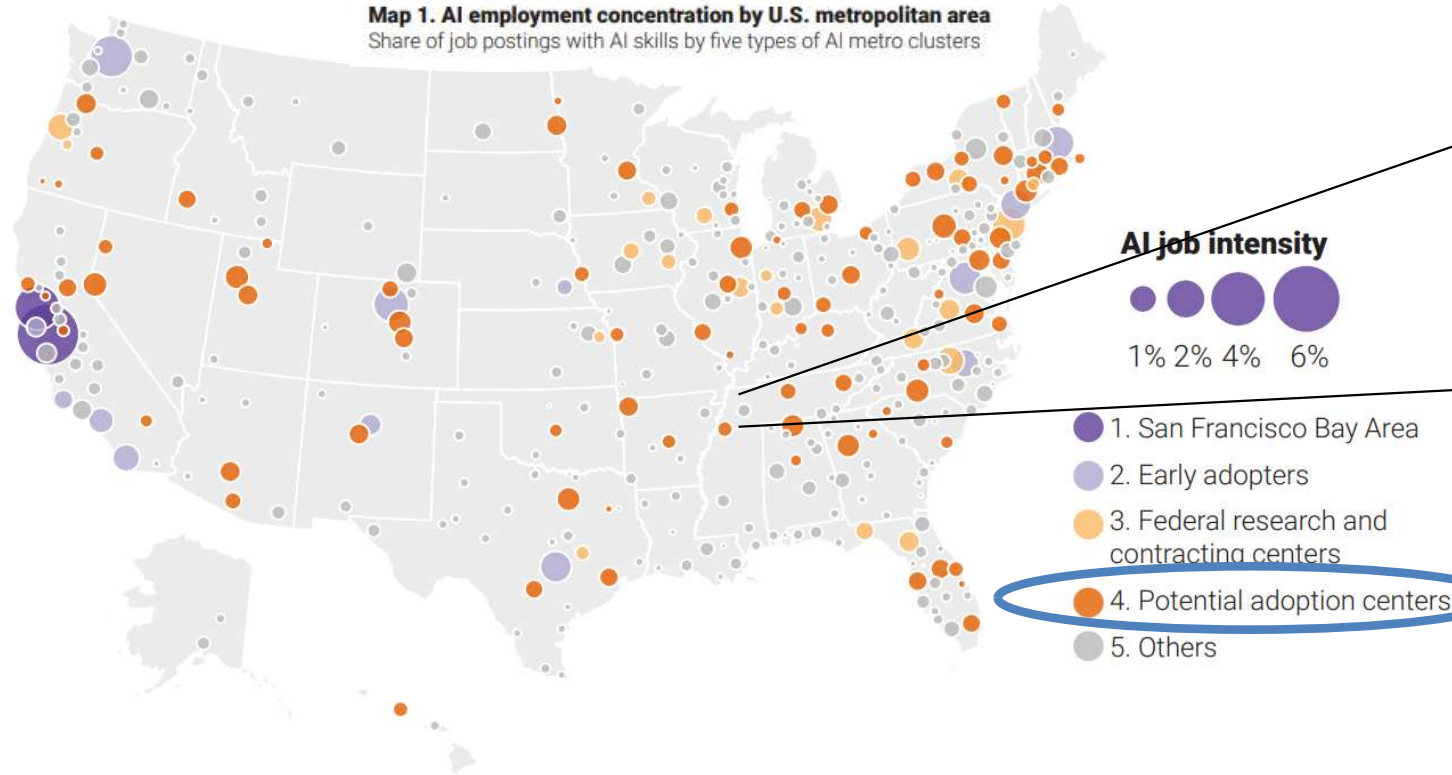**Percentage of today's workers in occupations that didn't exist in 1940**

85%

Percentage of employment growth over last 80 years due to technology-driven creation of new positions

Innovation leads to new occupations that account for most employment growth

Source: Autor et al. (2022), Goldman Sachs Research

Goldman Sachs

Source: Goldman Sachs Research, *05-Apr-2023*

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Tennessee is poised for AI growth

Map 1. AI employment concentration by U.S. metropolitan area
Share of job postings with AI skills by five types of AI metro clusters
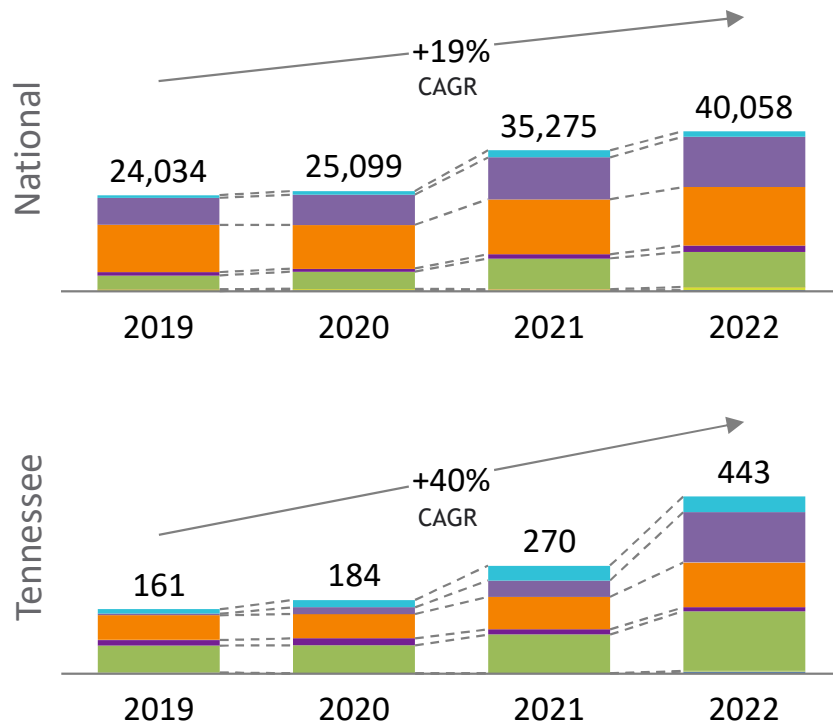
AI job intensity

1% 2% 4% 6%

1. San Francisco Bay Area
2. Early adopters
3. Federal research and contracting centers
4. Potential adoption centers
5. Others

Tennessee's largest metropolitan areas demonstrate AI leadership potential.

Brookings, "The geography of AI: Which cities will drive the AI Revolution?", Sept. 2021

AI-related employment is growing rapidly, with roles growing by 19% each year in the U.S., and 40% each year in TN…

Count of open job postings that require AI skills

National

+19% CAGR

2019	2020	2021	2022
24,034	25,099	35,275	40,058

Tennessee

+40% CAGR

2019	2020	2021	2022
161	184	270	443

Change in postings requiring AI skills since 2019

Industry	2022 U.S. job postings	Change from 2019
Forestry	17	+7
Agriculture & farming	310	+251
Manufacturing & materials	12,600	+5,900
Transportation & logistics	1,400	+726
Health	8,800	+5,400
Energy	748	+308
Information technology	14,600	+2,800
Hospitality & entertainment	1,600	+700

Note: Include in-person, remote, and hybrid jobs. Location of jobs is defined by the location listed for the position in the job posting
Source: Market analysis using Lightcast open roles data, seeking AI skills – industry is tagged to the hiring company using our NAICS industry mapping

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Summary

- The deployment and innovation of Artificial Intelligence (AI) holds great potential for economic advancement and the alleviation of social challenges within The State of Tennessee.

- The US Government is currently making significant investments in AI research and development to attain and maintain leadership in the global AI race.

- The State of Tennessee has a unique opportunity to become a pioneer in AI innovation and its transdisciplinary nature.

- Urgent action is needed to develop rigorous research that can effectively address these challenges.

- Respond to this challenge through the AI Tennessee Initiative to **advance** research capabilities and **contribute** to the broader advancement of the field of AI

AI Tennessee Initiative: the time is now!

AI Tennessee Initiative

- Research
- Education
- Infrastructure
- Partnerships
- Outreach & Engagement
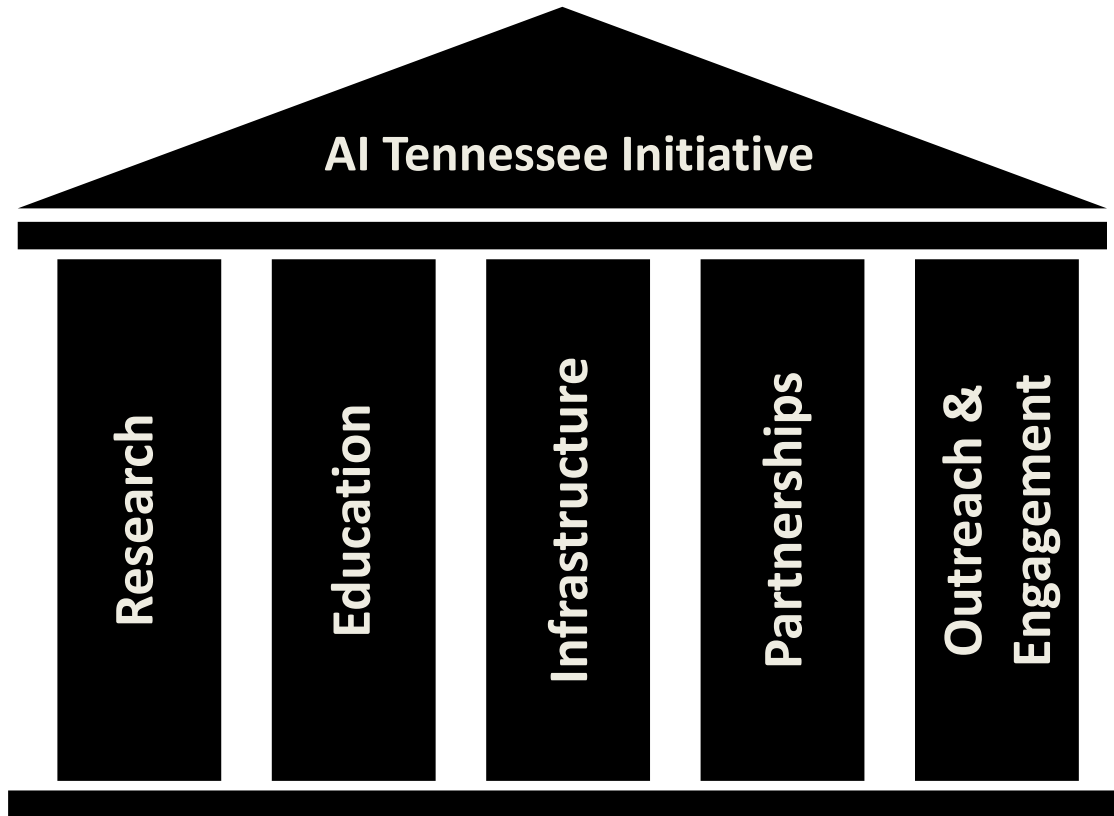
"Some advocates of artificial intelligence and data sciences say those fields are soon likely to enter a new era of development and growth in Tennessee. Momentum, they say, will be driven by growing demand for AI-Data tools, services, scientific and engineering research, and newfound knowledge, as well as by opportunities for Tennessee-based enterprises to compete nationally and perhaps globally as demand rises for powerful technologies and disruptive platforms."

—Venture Nashville Connections, Jan 2022

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Guiding Principles for AI Tennessee

- **Advancing Knowledge**

- **Recruiting and Retaining Top Talent**

- **Collaboration among TN/SEC/US institutions and Partnerships with Industry and National Labs**

- **Addressing Societal Challenges**
-
- **Economic Development**

- **Establishing and Reinforcing Transdisciplinary Platforms**

- **Fostering the Adoption of AI Technology**

Strengths, Opportunities, Aspirations

- **Agriculture and Farming:** unique landscape across our entire state

- **Manufacturing and Materials:** Tennessee is a high-tech hotbed with some of the most sophisticated manufacturing facilities in the world. The Institute of Advanced Manufacturing and Materials (IAMM) is one of the best facilities hosting research. CAMM an NSF MRSEC.

- **Transportation and Logistics:** Tennessee has many interstate arteries, including the i-40, the longest interstate. DoT invested in the Center of Transportation at UT

- **Health:** The State of Tennessee in all directions has well renowned facilities generating complex data cases surrounding health challenges including the socioeconomically challenged population in the Appalachia.

- **Data Science:** The universities in Tennessee, the Oak Ridge National Lab have contributed tremendously in the education, economy, workforce, and overall industrial ecosystem around AI across the State of Tennessee. For example, alumni from the various data science programs at UT are in key (hiring) positions shaping the future of AI and data science in industry in TN and beyond.

Strengths, Opportunities, Aspirations

- A unique opportunity to foster transdisciplinary research and development within the AI space.

- Distinct groups of researchers: AI developers, AI users, AI Security.
  - Cluster Hires on AI (AI4Science, Foundational AI, and AI + X)

- **AI Center of Excellence**
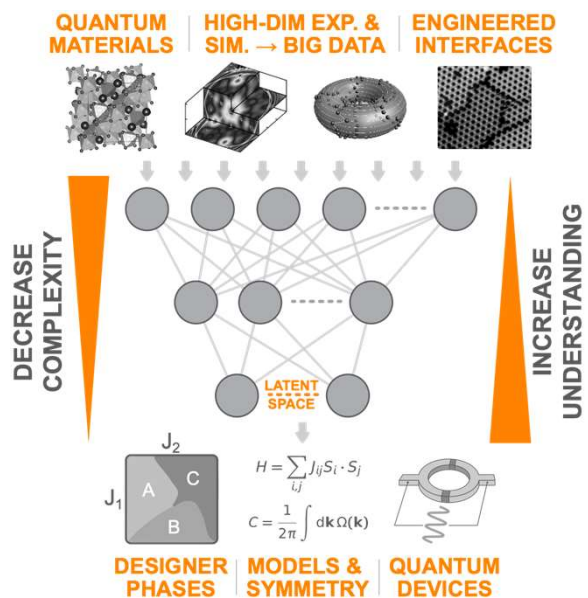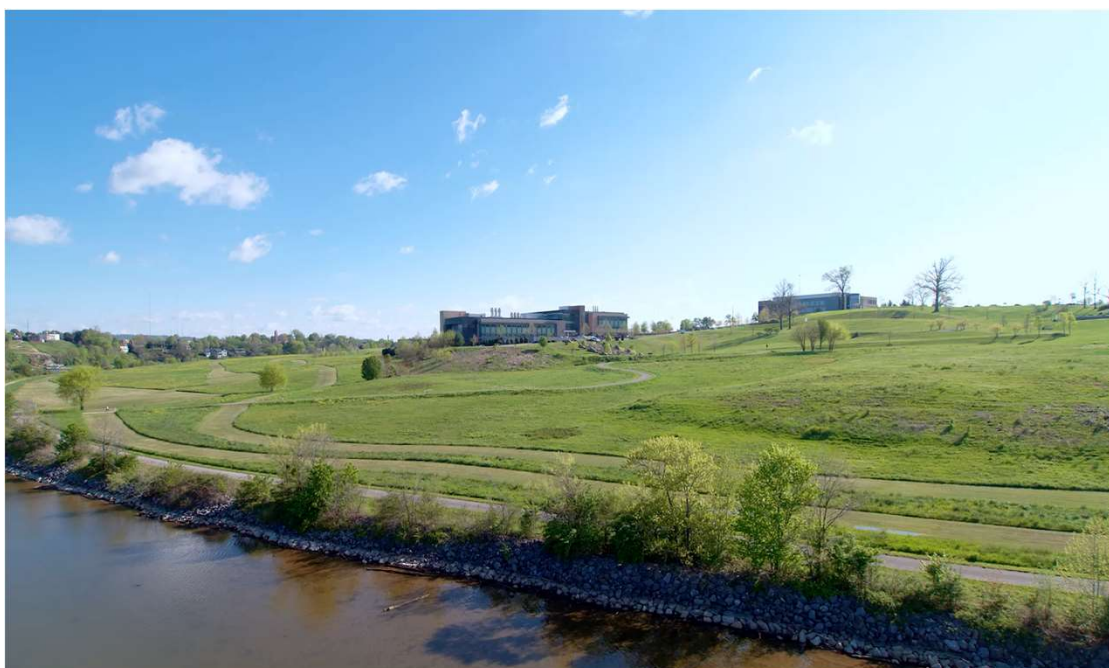
Strengths, Opportunities, Aspirations

- Establish our research ecosystem as a leading model for AI innovation and collaboration

- Invest on educating the new generation of researchers via a highly increasing number of accomplished and auspicious researchers.

- BRAIN GAIN: Retain the highly acumen AI workforce and contribute to the economy of our State.

- Engage AI with agriculture, industry, and the economy.

- The legacy of an AI Center of Excellence
  - ✓ Host of unique databases related to the strengths in our State: materials, manufacturing, health (human and animal), transportation, and agriculture.
  - ✓ Employment of FAIR (Findable, Accessible, Interoperable and Reusable) models to address these data problems.

CAMM

CENTER FOR ADVANCED MATERIALS & MANUFACTURING

QUANTUM MATERIALS | HIGH-DIM EXP. & SIM. → BIG DATA | ENGINEERED INTERFACES

DECREASE COMPLEXITY

INCREASE UNDERSTANDING

LATENT SPACE

J_2

J_1

A	C
	B

$H = \sum_{i,j} J_{ij} S_i \cdot S_j$

$C = \frac{1}{2\pi} \int d\mathbf{k}\,\Omega(\mathbf{k})$

DESIGNER PHASES | MODELS & SYMMETRY | QUANTUM DEVICES

https://camm.utk.edu

Transforming AI, Quantum and Energy Materials

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IRG1

Taming the Complexity of Quantum Materials with Artificial Intelligence

Lead: Adrian Del Maestro
Professor & Head: Physics & Astronomy
Professor: Min H. Kao Dept of Electrical
Engineering & Computer Science

Deputy: Yang Zhang
Assistant Professor: Physics & Astronomy,
Min H. Kao Dept. of Electrical Engineering
& Computer Science

IRG1: Multi-Investigator Interdisciplinary Approach

- Quantum materials research at a tipping point demanding **new AI approaches**

- IRG1 enables **team science** supported by the **experiments, materials, and cyberinfrastructure** provided by CAMM

- Experts in **physics, materials science, computer science, chemistry & mathematics**

- 14 faculty, 2 postdocs, 9 graduate students, ~15 undergraduate students
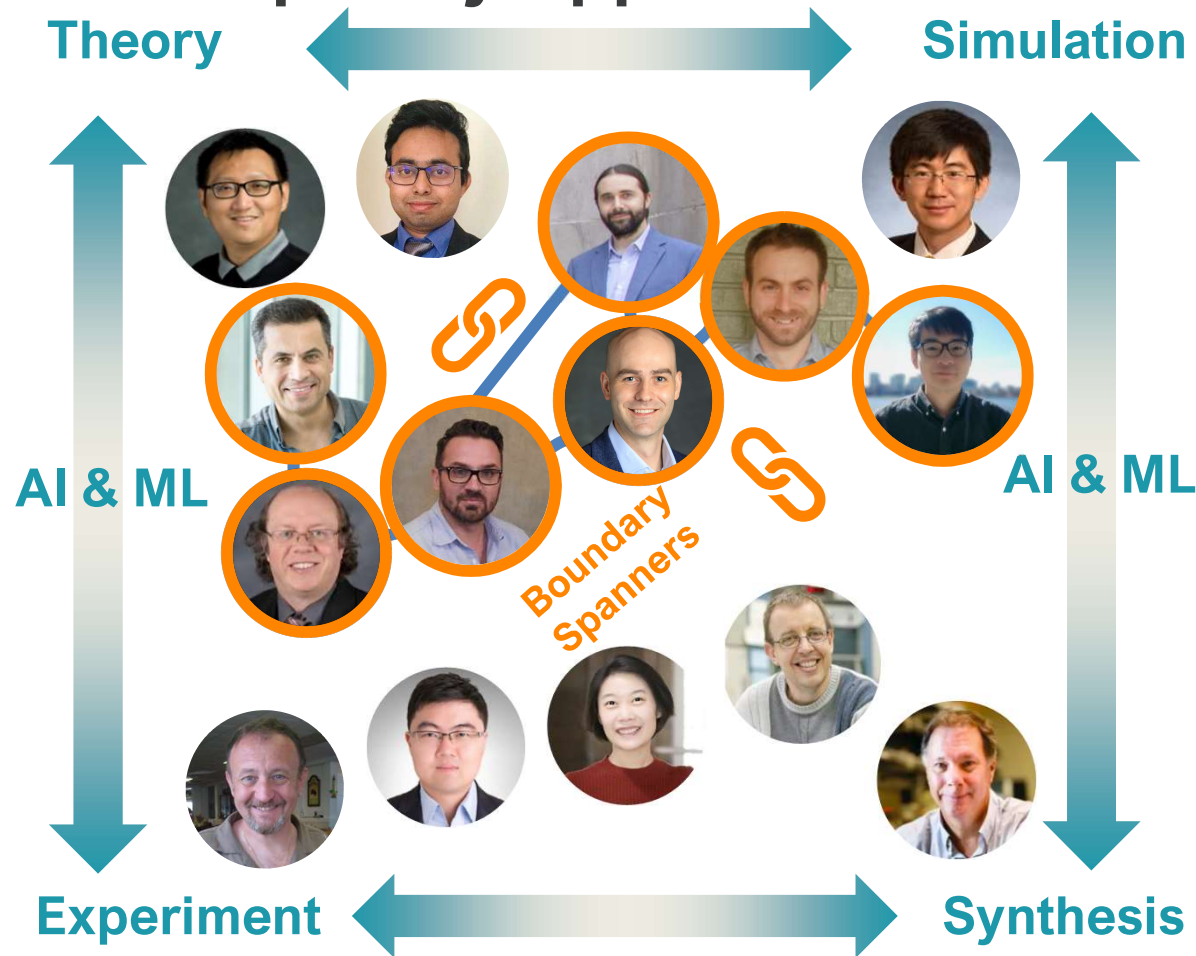
IRG1: Taming the Complexity of Quantum Materials with AI

Rationale:

- Quantum materials provide the foundations for technologies that will **power the quantum economy**

- Field is facing stagnation due to **big data + extreme complexity**

- **Single-investigator / single-domain approaches are lacking**

- Need new data-informed **artificial intelligence and machine learning** approaches to make progress

- Progress comes from **trust and embedding** of machine learning expertise with domain quantum materials science

- CAMM has the **intellectual, physical and cyberinfrastructure leadership** in both materials & AI

It's Working!

QUANTUM MATERIALS | HIGH-DIM EXP. & SIM. → BIG DATA | ENGINEERED INTERFACES

DECREASE COMPLEXITY

INCREASE UNDERSTANDING

LATENT SPACE

$$H = \sum_{i,j} J_{ij} S_i \cdot S_j$$

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DESIGNER PHASES | MODELS & SYMMETRY | QUANTUM DEVICES
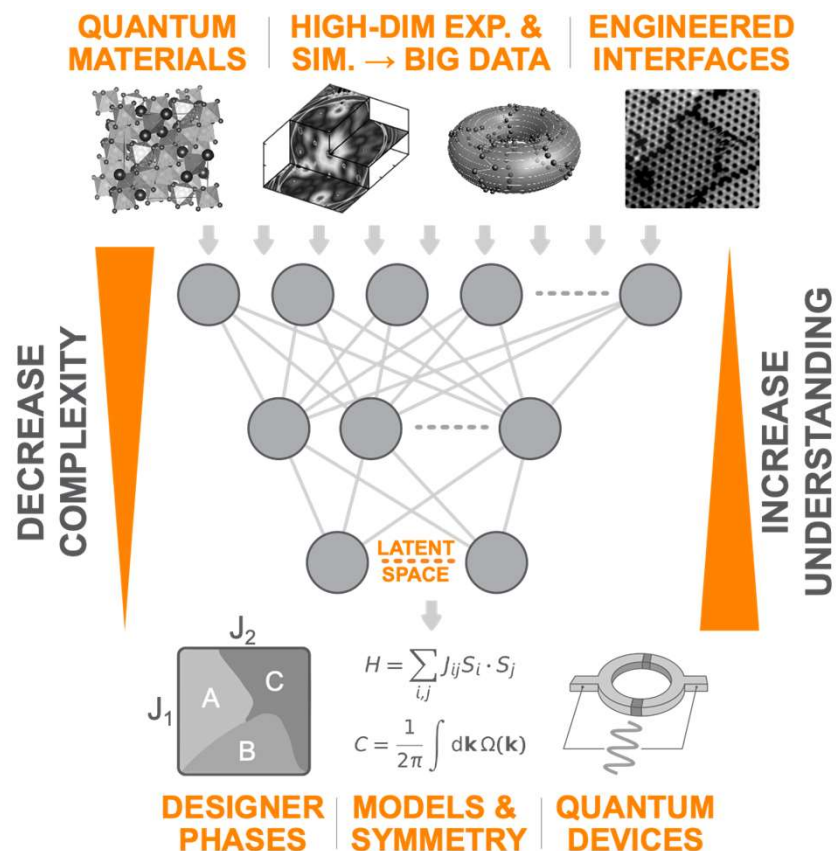
Year 1 Accomplishments

CAMM IRG1 Year-1 Highlights
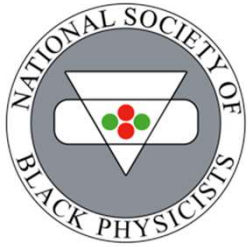
 Hosted NSBP during annual meeting

4 Invited presentations by IRG1 Investigators

25 Talks/seminars at internal meetings

2 Publications listing primary CAMM support

1 First-author CAMM undergrad paper

1 Senior faculty hire as part of ScAI cluster

3 Publications listing partial CAMM support
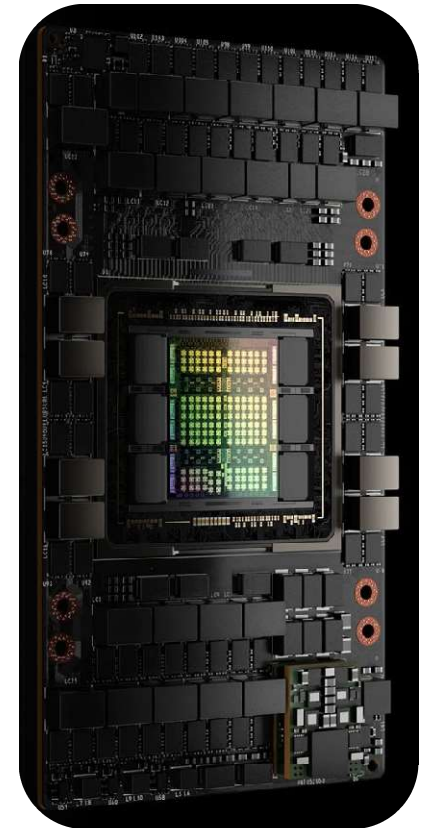
10 REU students working with IRG1 investigators

9 Graduate students advised by IRG1

CAMM AI-Accelerated Cyberinfrastructure

IRG1 Acquired & Installed

- Dell PowerEdge XE8640 server

- 64 core Intel Xeon Platinum 8462Y processor

- 4 NVIDIA H100 "Hopper" GPUs

- NVLink connections

- 1 TB of memory and 51 TB of NVMe storage

Enabling new AI workflows!

Unique CAMM Approach to FAIR Data

Code/paper repository

https://github.com/DelMaestroGroup/papers-code-GrapheneCorrugation

Data repository

https://zenodo.org/records/10137837

AI: Adopting Inclusion

"AI is too big for any one perspective, never mind the fact that no two people seem to see things the same way" –J. Brockman