Accelerating AI's Positive Impact through Transdisciplinary & Regional Research Collaboration

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THE UNIVERSITY OF TENNESSEE KNOXVILLE

Key Messages

1) Those who can leverage AI in their jobs will thrive.

2) Tennessee is well-positioned to take advantage of new AI-related opportunities.

3) The AI Tennessee Initiative aims for Tennessee to become a leader in the data-intensive knowledge economy through research and education, in partnership with industry and the community.
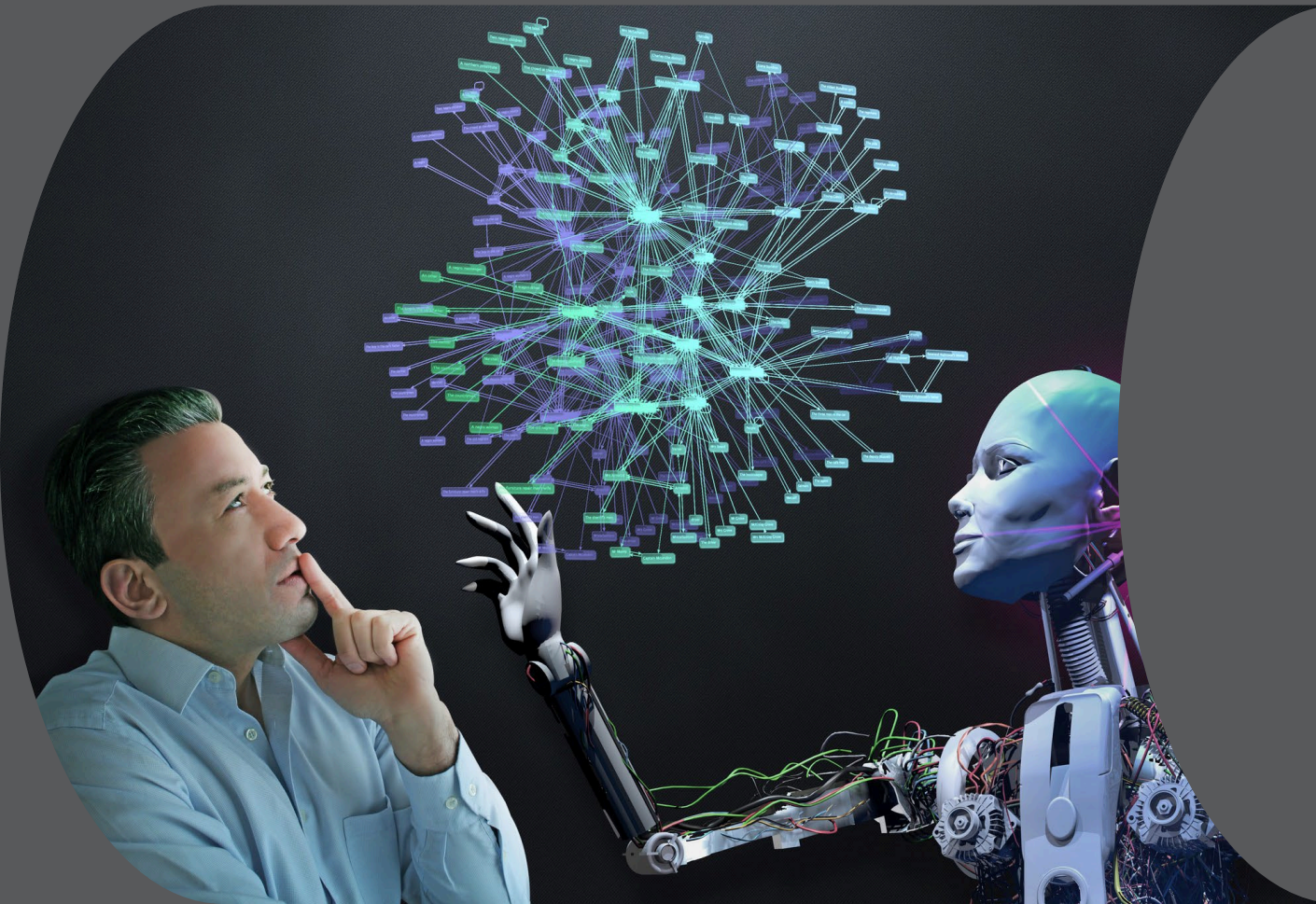
1) Those who can leverage AI in their jobs will thrive.

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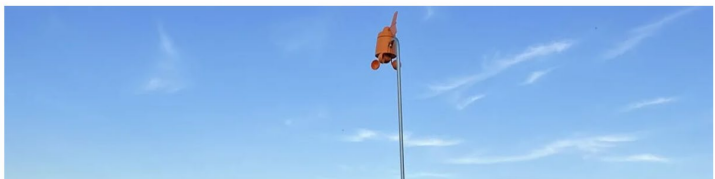
by Michael Gauthier   June 15, 2023 at 07:31   6

Sanofi signs latest billion-dollar AI drug discovery deal

Artificial intelligence to command autonomous John Deere machinery

11-10-2022 | Autonomous/semi-autosteering systems | News

...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**

1.Source: Grandview Research. Artificial Intelligence Market Size, Share & Trends Analysis Report By Solution, By Technology (Deep Learning, Machine Learning), By End-use, By Region, And Segment Forecasts, 2023 - 2030
2."Exposure" a is proxy for potential economic impact that reflects the technical capacity to make human labor more efficient w/o distinguishing between augmenting or displacing
Source: GPTs are GPTs: An Early Look at the Labor Market Impact Potential of Large Language Models – OpenAI, OpenResearch & Upenn

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AI is impacting and transforming the workplace
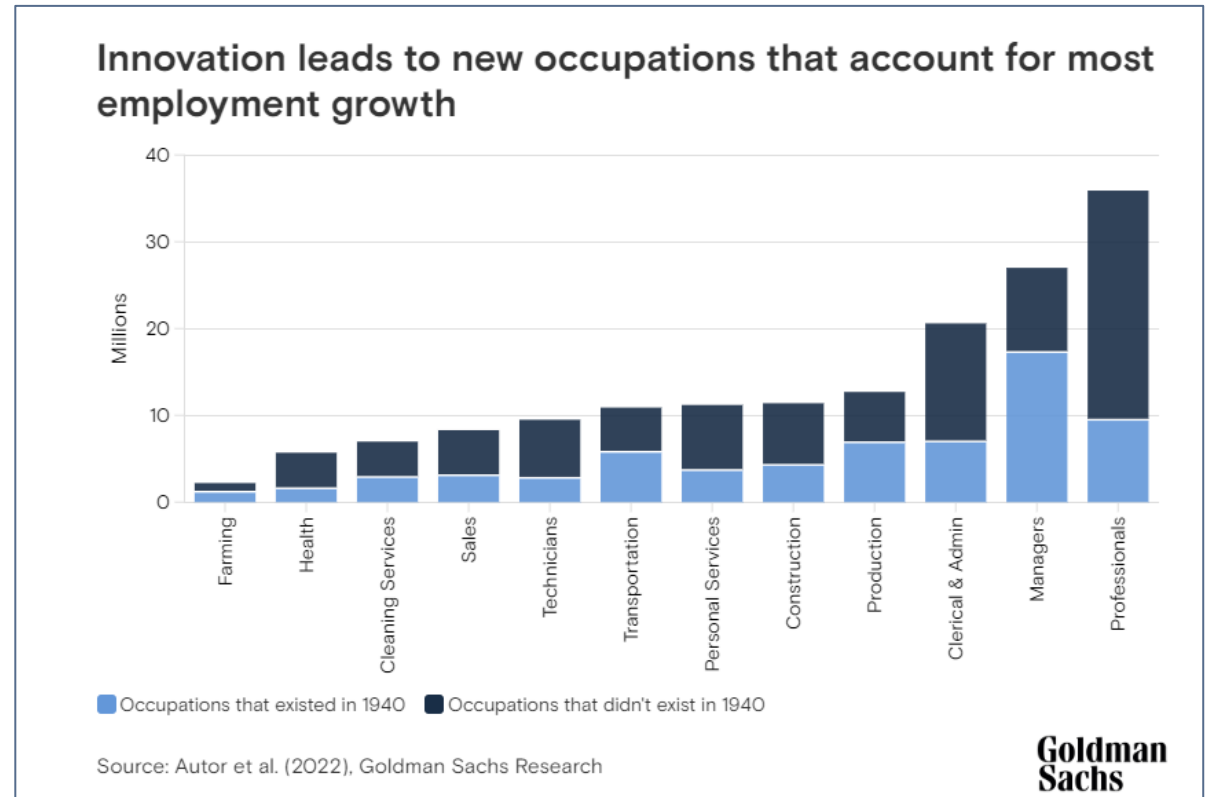
2/3
Fraction of U.S. occupations that could be partially automated by AI

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

Millions

40
30
20
10
0

Farming · Health · Cleaning Services · Sales · Technicians · Transportation · Personal Services · Construction · Production · Clerical & Admin · Managers · Professionals

■ Occupations that existed in 1940   ■ Occupations that didn't exist in 1940

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

Goldman Sachs

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

AI Will Impact Key Economic Sectors Across Tennessee

In examining eight industries in Tennessee, BCG analyzed available data to assess how each industry will be impacted by AI…

	Forestry	Agriculture	Manuf. & Materials	Trans. & Logistics	Health	Energy	IT	Hospitality & Ent.
National employment in the industry (2022, thou. jobs)	760	3,489	11,290	7,370	18,970	2,460	5,070	16,730
Tennessee employment in the industry (2022, thou. jobs)	19	82	307	215	395	49	77	359
Funding to AI-related companies in the industry (2021,$M)	13	1,680	34,100	14,373	49,500	4,670	35,400	5,200

Source: U.S. Bureau of Labor Statistics. Netbase-Quid; BCG Center for Growth & Innovation Analytics

…to develop a perspective on each industry's **AI potential**, and **benefit for Tennessee businesses and people**

…and enriched these measures with perspectives on existing Tennessee assets, barriers to adoption of AI, and societal benefits for Tennessee…

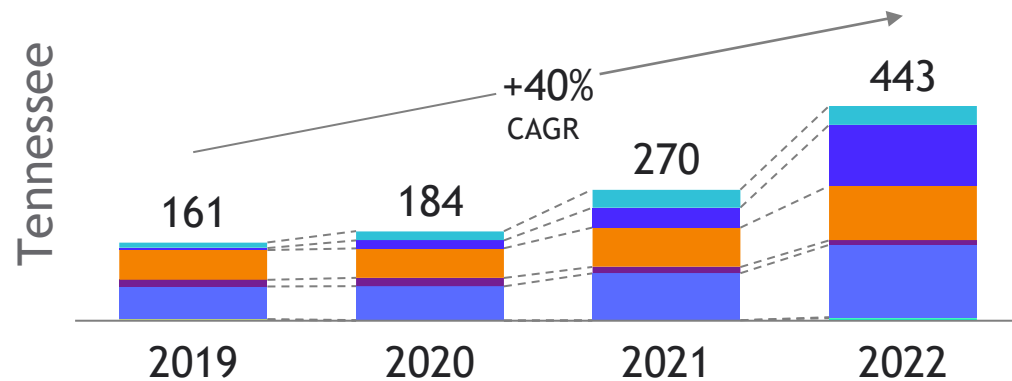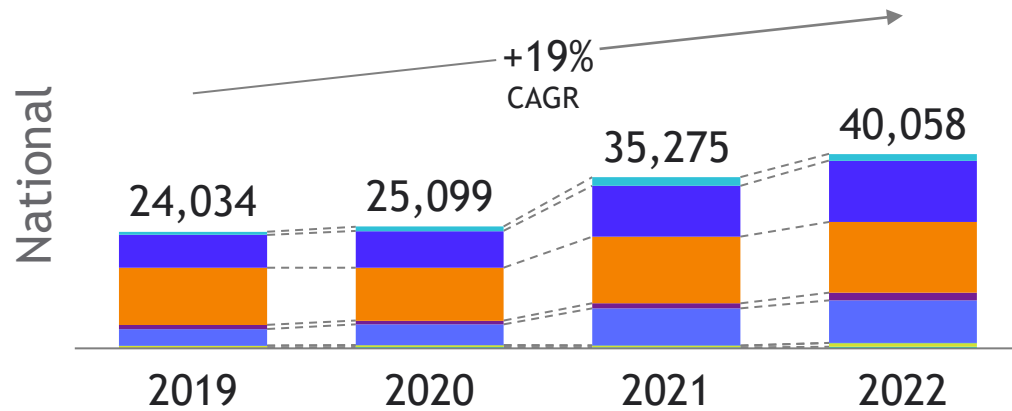"AI won't take your job. It's somebody using AI that will take your job."

RICHARD BALDWIN, ECONOMIST

2023 WORLD ECONOMIC FORUM

AI-related employment is growing rapidly
*Based on UT-commissioned study by BCG (Summer '23)

Count of open job postings that require AI skills

National

+19% CAGR

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

Tennessee

+40% CAGR

- 2019: 161
- 2020: 184
- 2021: 270
- 2022: 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

Source: Market analysis using Lightcast open roles data, seeking AI skills – industry is tagged to the hiring company using BCG NAICS industry mapping
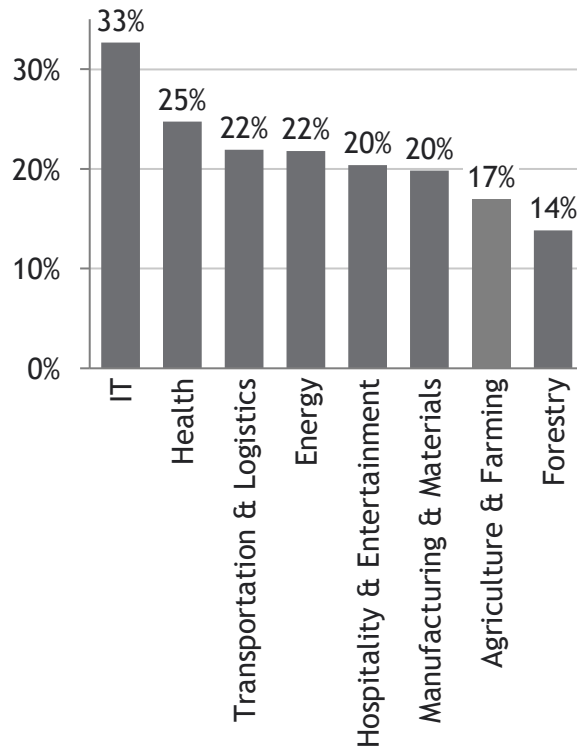
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…but AI is also driving evolution in major U.S. jobs, creating employment disruption and need for reskilling

Exposure to Large Language Models

17% of roles will be exposed[1] to LLMs

Industry	Exposure
IT	33%
Health	25%
Transportation & Logistics	22%
Energy	22%
Hospitality & Entertainment	20%
Manufacturing & Materials	20%
Agriculture & Farming	17%
Forestry	14%

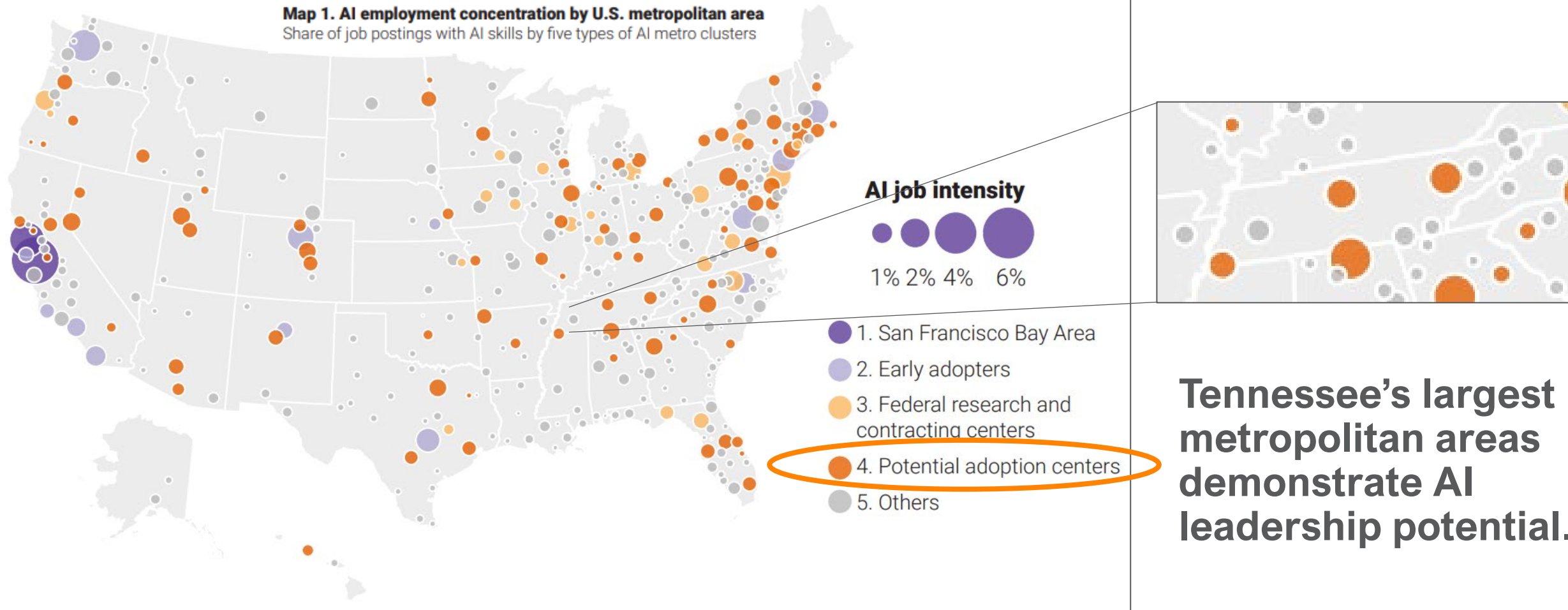| Top Roles Across Industries	US Total Employees	Degree of role evolution and need for re-skilling
Counter Workers (incl. Fast Food)	9,946,000	●●●● Cashiers will need to integrate with increased digital touchpoints – from self check-out troubleshooting to points redemption; opp'ty varies based on infrastructure needs
Customer Service Representatives	2,880,000	●●●● GenAI customer service functionality means only complex cases will reach human representatives; generational trend toward chatbots will increase over time
Software Developers	1,535,000	●●●● From data cleaning to flagging key user feedback to systems design to code generation, the end-to-end workflow can be fully integrated with AI tools
Heavy and Tractor-Trailer Truck Drivers	1,984,000	●●●○ Autonomous driving in 6-10-year term; need to partner effectively with AI routing and safety tools
Registered Nurses, LPNs, and LVNs	3,705,000	●●●○ AI co-pilots can take notes, suggest treatment plans, set care reminders, and keep family in the loop; nurses have to integrate suggestions thoughtfully
Miscellaneous Assemblers and Fabricators	1,454,000	●●○○ Acceleration of tedious, high-precision tasks which will increase throughput and create opportunities to focus on other skills
Laborers and Freight, Stock, and Material Movers	2,934,000	●●○○ Need for manual labor will not disappear, but in contained spaces robotics will become more prevalent; instructions around safety and QA will integrate with workflows

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1) **Those who can leverage AI in their jobs will thrive.**
2) Tennessee is well-positioned to take advantage of new AI-related opportunities.
3) The AI Tennessee Initiative aims for Tennessee to become a leader in the data-intensive knowledge economy through research and education, in partnership with industry and the community. To do so, we need a coordinated vision and action plan targeting key opportunities across Tennessee.

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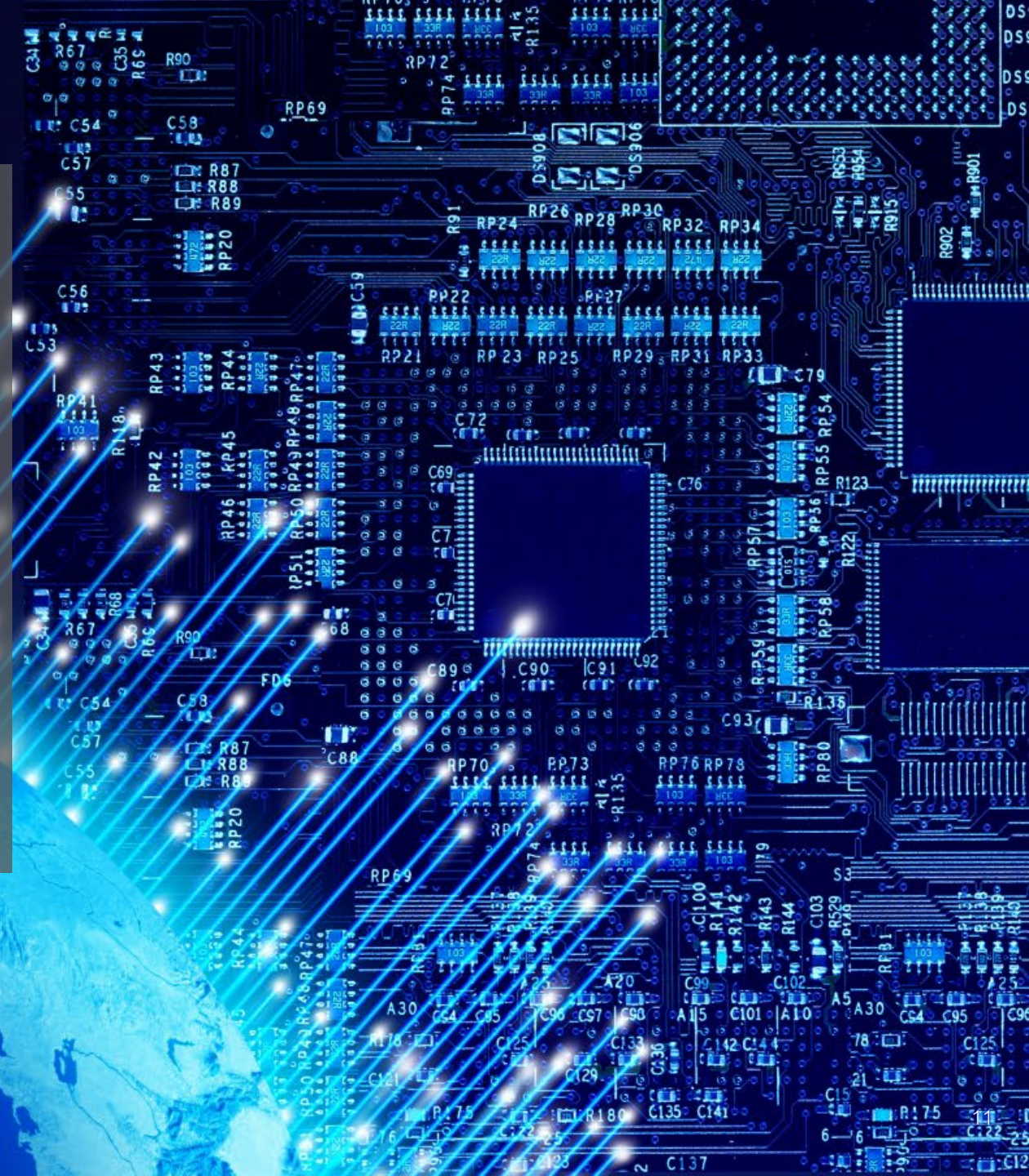
Tennessee is poised for AI growth

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

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Most key economic sectors in Tennessee hold promise for AI

FORESTRY
Hardwood forests among top in the country, with above average employment given state size. AI can protect natl. resources

AGRICULTURE & FARMING
Major driver of land usage within TN; AI can drive impact across the state, lower food costs, & improve the environment

MANUFACTURING & MATERIALS
Strong anchor employers (e.g., VW, Nissan, Bridgestone), high employment, & potential for **cross-industry impact**

TRANSPORTATION & LOGISTICS
TN's location allows access to 80% of U.S. markets within a day; **top-tier Memphis hub and top employers** (e.g., FedEx)

HEALTHCARE
TN **boasts wide array of provider systems.** AI in HC has highest potential **impact for health outcomes and equity**

ENERGY
TVA is a strong anchor utility; existing **ed-employer partnerships** create talent pipelines; potential for equity & environmental impacts

IT
TN seeing **almost double the growth in IT** compared to the national average; top funded, cross-cutting sector

HOSPITALITY & ENTERTAINMENT
Top entertainment hub in Nashville, with assets around the state; **cross-cutting applications** drive service delivery

1.

*Based on UTK-commissioned study conducted by BCG, Summer 2023

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AI TENNessee Initiative

Transdisciplinary
Education & i**NN**ovation

Vision

Tennessee becomes a national and global leader in the data-intensive knowledge economy.

Goals

- Leverage unique strengths and opportunities of Tennessee
- Advance cutting-edge research across all disciplines
- Prepare Tennessee's students for AI-enabled jobs of today and the future
- Partner with industry, organizations, and institutions across the State

AI TENNessee Initiative:
Strategic Pillars

- Research
- Education
- Infrastructure
- Partnerships
- Outreach & Engagement
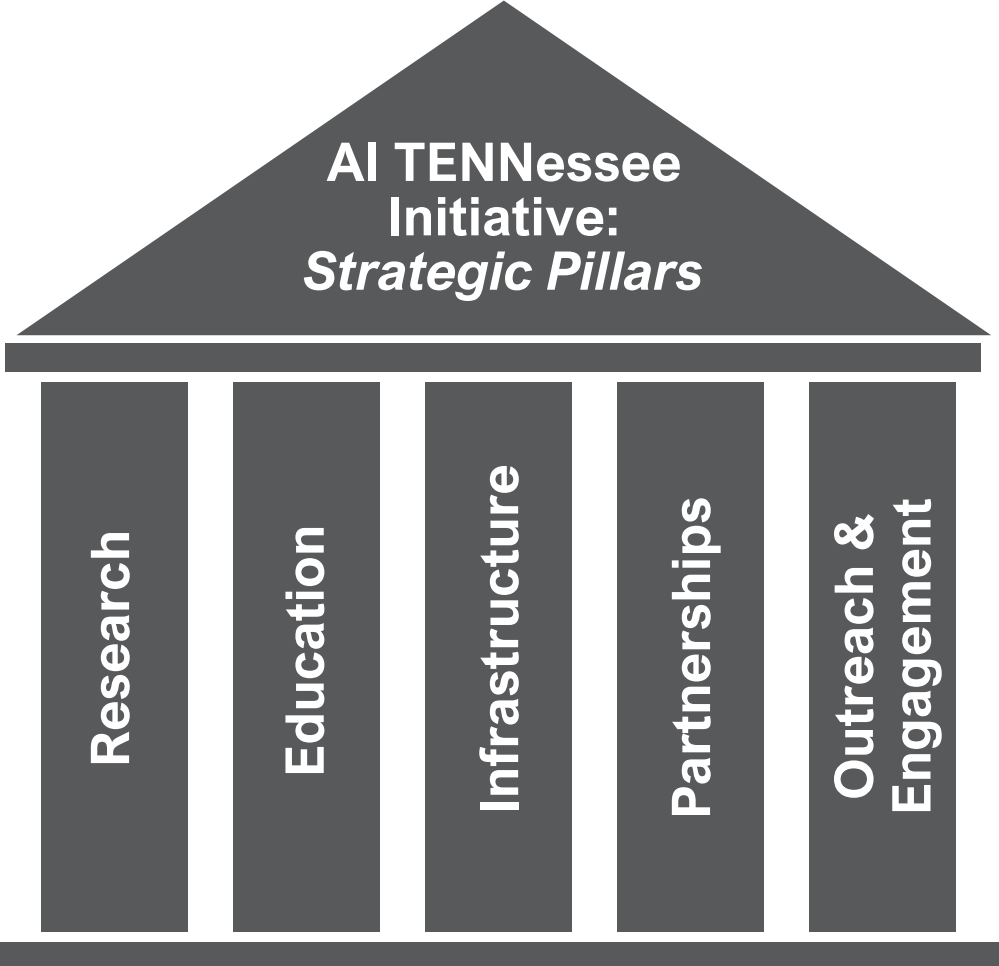
Recent AI advances are motivating more use-inspired AI research

The Economist

Sep 13th 2023

Could AI transform science itself?

Previous scientific revolutions have been led by academic journals and laboratories. Robots might create the next one

"When [Dr. Yolanda Gil] surveyed attitudes towards AI in science in 2014, she found that, in most fields, 'interest in AI seems relatively limited'. Most efforts to incorporate AI into the scientific research came from AI researchers, who were often met with skepticism or hostility. But the impact of AI is now 'profound and pervasive'… Many scientists … are now 'proactively seeking AI collaborators'…"

AI research: expand, strengthen & energize
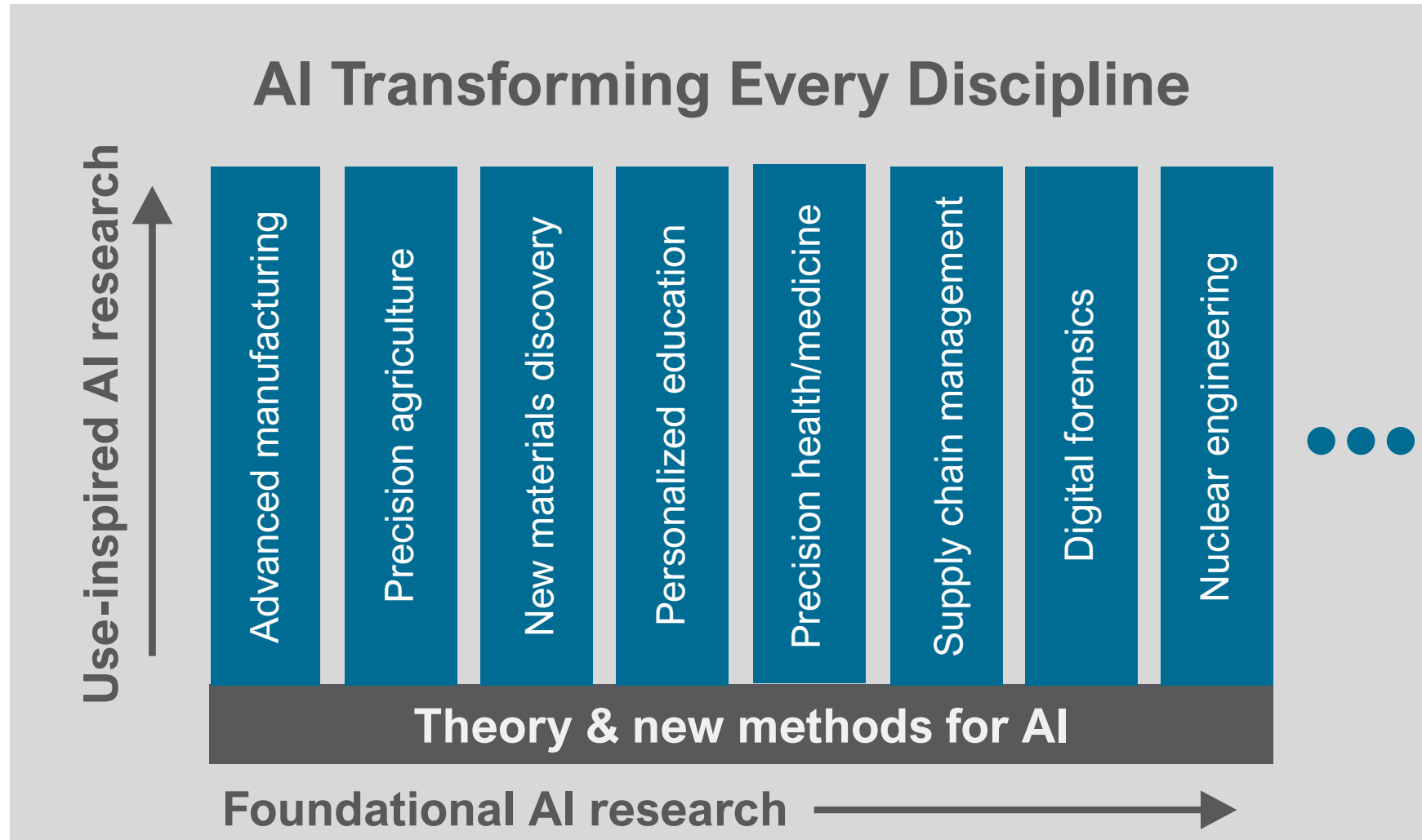
AI TENNessee Initiative [Research]: UT Faculty Cluster Hires

Purpose: Recruit interdisciplinary faculty clusters in AI to address some of the most pressing challenges and exciting opportunities of our times

Approach:
- UTK is committing funds over 5 years to recruit top faculty members to 7 clusters across multiple disciplines, including an emphasis on AI
- Current faculty lead cluster hiring process, aiming to build on existing expertise to grow the scholarly and educational impact of our research

THE UNIVERSITY OF TENNESSEE KNOXVILLE **NEWS**

TOPICS

Campus News >
Arts & Design >
Business & Economy >
Education & Society >

CAMPUS NEWS

UT Commits $50 Million to Transdisciplinary Cluster Hires

DECEMBER 7, 2022

Clusters with AI focus or component:
- **Foundational AI** – closing the gap to Human Intelligence
- **Science-informed AI** – scientific/mathematical AI for intelligent engineering
- **Future Mobility** –automation of transportation and smart infrastructure
- **Climate-Smart Agriculture & Forestry** – AI for crop health, forest management planning, etc.
- **Bioinformatics, Genomics, and Quantitative-based Solutions for Food Security** – data science & machine learning (ML) for plant production, etc.
- **Precision Health & Environment** – ML for causal linkages between genetics, environmental factors, and health outcomes

Benefits & Potential Impact:

- Create knowledge and opportunities to benefit communities in our state and nation, and around the world
- Foster translational research that makes life and lives better and prepare UT graduates to lead in the communities and workplaces of the future
- Enhance university's research excellence, foster opportunities for transdisciplinary collaboration, and develop real-world solutions to grand challenges

AI TENNessee Initiative [Research & Education]: Advancing Transdisciplinary Initiatives with AI

Purpose: Leverage AI to advance large-scale initiatives across a wide range of disciplines and discoveries

Approach:

Develop translational and use-inspired AI innovations to pursue discoveries in large-scale initiatives from next-generation materials and advanced manufacturing, to advanced mobility, to energy and environment, to human health and wellness

Educate and train students and new researchers in the application of AI across multiple disciplines

NSF News

NSF Director Panchanathan meets three Members of Congress at the University of Tennessee, Knoxville, for project kick-off, announces funding for UT's advanced materials and manufacturing center

June 26, 2023

National Science Foundation

U.S. National Science Foundation Director Sethuraman Panchanathan with Sen. Marsha Blackburn (R-TN), Sen. Bill Hagerty (R-TN), and Rep. Tim Burchett (R-TN) at the University of Tennessee, Knoxville.
Credit: Amanda Greenwell/NSF

Example Activities and Plans:

- **Future Mobility Initiative (May 2023):** NSF announces $1M UT-led statewide coalition "TEAM TN" to shape future of mobility, funded by NSF's Regional Innovation Engines Program

- **Material Research Science and Engineering Center (June 2023):** New $18M NSF-funded center at UT to develop sophisticated AI and computational tools and deploy them in the design and synthesis of next-generation materials: quantum materials, & materials for extreme environments

Benefits & Potential Impact:

- Accelerates multidisciplinary discovery, education, and workforce development
- Enables groundbreaking advances to address complex challenges across transdisciplinary domains
- Encourages innovation at the intersection of disciplines, leading to transformative breakthroughs
- Fosters collaboration and knowledge exchange across disciplines, encouraging innovative problem solving
- Promotes impactful applications of AI that lead to economic, societal, and security benefits

AI TENNessee Initiative [Infrastructure]:
$1M in New AI Computational Infrastructure

Purpose: Provide expanded computational infrastructure to enable compute-intensive AI research at UT

Approach:

➤ Invest $1M in new AI-relevant computational infrastructure

➤ Held campus-wide AI Research Computing Symposium to discuss computationally-intensive AI research needs at UTK

➤ Based on input, the decision was made to purchase 8 Dell XE8640 servers equipped with 4 NVIDIA H100s GPUs (32 GPUs in total), significant NVMe flash storage, and Infiniband

ARTIFICIAL INTELLIGENCE

HIGH PERFORMANCE & SCIENTIFIC COMPUTING

Artificial Intelligence Research Computing Symposium

May 17, 2023
9AM-5PM

UTK presentations on diverse AI topics:
• Quantum chemistry for molecular discovery
• Machining stability prediction
• Smart manufacturing & industry 4.0
• Alzheimer's care using AI
• Analysis of healthcare claims data
• Understanding/improving Supercomputer property homogeneity
• Mass and thermal transport

Activities and Timeline:

• **Spring 2023:** Evaluation of need and available GPU/CPU options

• **May 17, 2023:** Campus-wide AI Research Computing Symposium informing new hardware needs

• **Oct 2023:** New AI GPU hardware available

Benefits & Potential Impact:
• New hardware balances price, performance, capability, and expandability for compute-intensive AI applications
• NVIDIA H100s are latest generation GPU and are well-tuned for AI/ML workloads.
• High speed and low latency NVMe flash memory will decrease performance bottlenecks of datasets to/from the GPUs
• Empowers researchers to efficiently handle data-intensive AI/ML workloads, reduce training times, and enhance research productivity

AI TENNessee Initiative [Education]:
New UT AI courses for students of all disciplines

Purpose: Provide opportunities for students across all disciplines to understand the foundational concepts, techniques, and applications of AI

Approach:

- Introduce new courses with no prerequisites, which provide a foundational understanding of AI to students across campus, team taught by faculty from multiple disciplines.

- Taught by new College of Emerging and Collaborative Studies (CECS)

New AI courses to be designed and taught
- *Fall '23: AI 101: Introduction to the World of AI*
  Explore history and scope of AI, data sources and procedures for working with data, fundamental components of AI solutions. Study strengths and weaknesses of methods, as well as ethical considerations.

- **Spring '24:**
  - *AI 401: Exploring the World of AI*
    Similar to AI 101 but explores more technical tools and introduces students to AI-relevant programming.
  - *AI 501: Exploring the World of AI*
    Similar to AI 401, but with a research focus

Benefits & Potential Impact:

- Provides benefits to all students, regardless of focus of study and level of technical proficiency, to develop an understanding of AI and put this knowledge in the context of real-world applications within their areas of expertise

UT's new AI 101 Course (Fall '23)

AI 101 - Introduction to the World of AI

AI 101 - Introduction to the World of AI

3 *Credit Hours*

Introduction to foundational concepts, techniques, and applications of Artificial Intelligence (AI) relevant for all disciplines – especially across non-computer science fields. Explores the history and current scope of AI, data sources and tools, and fundamental components of AI solutions. Special attention will be placed on the strengths and weaknesses of the methods as well as on identifying bias, social impacts, and other ethical considerations of AI. Students will gain experience through hands-on activities using no-code AI platforms.

AI 101 syllabus:
- Foundations of AI
- Ethics of AI
- Understanding data
- Evaluating AI solutions
- Current AI tools
- Machine learning w/ no-code tools
- Deep learning w/ no-code tools
- NLP w/ no-code tools
- Computer vision w/ no-code tools
- Intelligent agents, robotics, expert systems
- Case studies & applications

Taught by new UT College of Emerging and Collaborative Studies

UT's new AI 401/501 Courses (Spring '24)

AI 401 - Exploring the World of AI

AI 401 - Exploring the World of AI
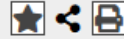
3 *Credit Hours*

Detailed study of concepts, techniques, and applications of Artificial Intelligence (AI) relevant for all disciplines – especially across non-computer science fields. Explores the history and current scope of AI, data sources and procedures for attaining and working with data, and fundamental components of AI solutions. Special attention will be placed on the strengths and weaknesses of the methods as well as on identify[...] impacts, and other ethical considerations of AI. Introduces students to AI-relevant programmin[...] hands-on coding projects. This is an undergraduate and graduate course (AI 501) taught conc[...] graduate students will have additional requirements and assignments.

Credit Restriction: Students cannot receive credit for both AI 401 and AI 501.

Taught by new UT College of Emerging and Collaborative Studies

AI 501 - Exploring the World of AI

AI 501 - Exploring the World of AI

3 Credit Hours

Detailed study of concepts, techniques, and applications of Artificial Intelligence (AI) relevant for all disciplines – especially across non-computer science fields. Explores the history and current scope of AI, data sources and procedures for attaining and working with data, and fundamental components of AI solutions. Special attention will be placed on the strengths and weaknesses of the methods as well as on identifying bias, social impacts, and other ethical considerations of AI. Students will investigate state-of-the-art AI used within their fields of research. Introduces students to AI-relevant programming through hands-on coding projects.

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AI TENNessee Initiative [Education]: K-12 Education Emphasis

Purpose: Advance AI literacy in K-12 schools across Tennessee, empowering students to achieve their dreams and create a better future in the age of AI

Approach:

"Teach the teachers" and conduct AI pilots in Title I schools across Tennessee

Leverage teacher scholarships and curricula provided by the AI Education Project (aiEDU.org), a non-profit organization that creates equitable learning experiences that excite and empower students with AI literacy
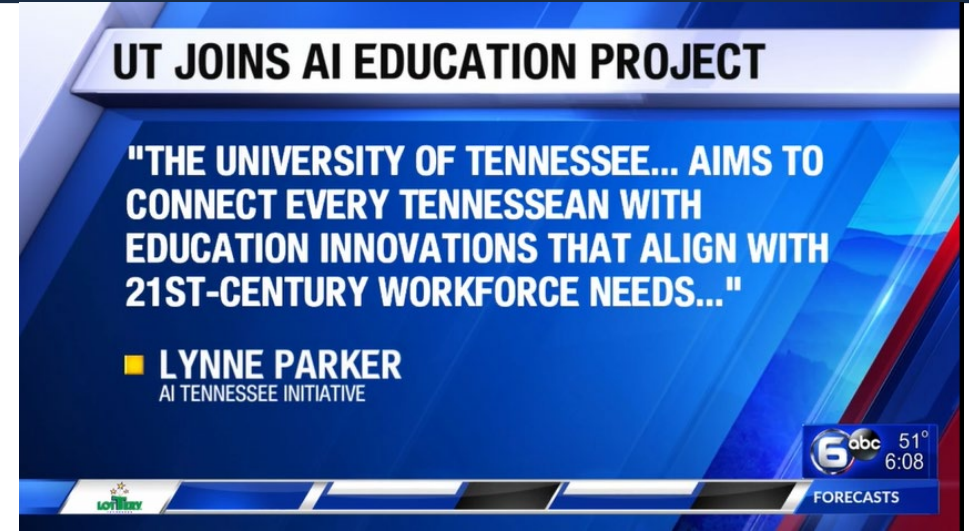
Activities and Plans:
- *March '23:* UT partnered with aiEDU in the Call to Action for AI Education, committing to advance AI education for teachers and students across Tennessee
- *Summer '23:* Outreach to Tennessee teachers via the East Tennessee STEM Hub, as part of the Tennessee Dept of Education's Tennessee STEM Innovation Network
- *Fall '23*: Provide teacher training during their district professional learning days
- *Spring '24*: Tennessee teachers pilot AI courses in districts across the State

Benefits & Potential Impact:
- Connect every young Tennessean with education innovations that align with 21st-century workforce needs
- Provide Tennesseans – especially those who are likely to be disproportionately impacted by AI systems – with access to the conceptual knowledge and skills they need to thrive as workers, creators, consumers, and citizens
- Empower teachers with skills they need to advance AI literacy in their classrooms
- Seamlessly integrate AI curricula to advance Tennessee's K-12 Computer Science Standards

POC: Lynne Parker, Associate Vice Chancellor and Director, AI Tennessee Initiative, leparker@utk.edu; Collaborators include Lynn Hodge, Josh Rosenberg, and Sukanya Moudgalya, from College of Education

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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Thank you!!

Questions?

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