



# Artificial Intelligence: The Vitals

The National Institute of Standards and Technology (NIST) aims to cultivate trust in the design, development, use, and governance of Artificial Intelligence (AI) technologies and systems in ways that enhance safety and security and improve quality of life. NIST focuses on improving measurement science, technology, standards, and related tools – including evaluation and data.



With AI and Machine Learning (ML) changing how society addresses challenges and opportunities, these technologies must be trustworthy and embedded in responsible practices. Trustworthy AI systems are those demonstrated to be valid and reliable, safe, secure and resilient, accountable and transparent, explainable and interpretable, privacy-enhanced, and fair with harmful bias managed. The agency's AI goals and activities are driven by its statutory mandates, Presidential Executive Orders and policies, and the needs expressed by U.S. industry, the global AI research community, other federal agencies, and civil society.

NIST's AI goals include:

## Conduct Fundamental Research and Produce Guidelines to Advance Trustworthy AI Technologies

NIST's AI portfolio includes fundamental research, development, and standards vital for trust in AI technologies. This work includes efforts on software, hardware, architectures, the ways human interact with AI technology, and AI-generated information.

### Establishing and Promoting Technical Requirements for Trustworthy and Responsible AI

- NIST identifies and quantifies trustworthy and responsible AI in technical terms and develops tools and guidance so that designers, developers, and evaluators can act. This includes developing taxonomy, terminology, and testbeds for measuring AI risks, as well as standards for key technical characteristics of AI trustworthiness.
- As mandated by Congress, NIST has developed a voluntary AI Risk Management Framework. The framework was worked on collaboratively with public and private stakeholders, many of whom are now implementing it and using its companion Playbook.
- NIST has established a Trustworthy and Responsible AI Resource Center, a "one stop shop" for foundational content, technical documents, and toolkits.
- Carrying out an October 30, 2023, Presidential Executive Order, NIST is producing multiple guidelines and taking other actions to advance the safe, secure, and trustworthy development and use of AI.
- NIST has established the US AI Safety Institute and a related Consortium to empower a new measurement science.

### Hardware for AI: Creating New Measurements and Technical Approaches for New AI Chips

- NIST is helping develop devices, circuits, systems, measurements, and theory to support the evolution of new AI hardware from laboratory research to commercial applications. NIST is focusing on scalability, energy efficiency, hardware optimization, and architecture development. The new physical computation mechanisms and intelligent functionality call for new measurement techniques and protocols.

## Apply AI Research and Innovation Across the NIST Laboratory Programs

NIST's multidisciplinary laboratories offer an ideal environment to develop and apply AI.

### Exploring Research Frontiers by Incorporating AI and ML

- NIST researchers are developing partnerships across the Institute and with academia, other government laboratories, and industrial entities. Key focus areas include innovative measurements using AI/ML techniques, predictive systems using AI/ML models, and enabling and reducing the barriers to autonomous measurement platforms.

### Producing Training Data, Algorithms, and Other Tools

- NIST's technical staff are working on key practices for documenting and characterizing datasets, and developing datasets that the broader community can use to test or train AI systems. The agency is expanding the availability of algorithms, test or training data, and other tools for domain-specific applications including advanced materials, computer vision, design, industrial robotics, natural language processing, spectrum management, and video processing.

## Establish Benchmarks, Data, and Metrics to Evaluate AI Technologies

With a long history of devising and revising metrics, measurement tools, standards, and testbeds, NIST increasingly is focusing on measurement and evaluation of technical characteristics of trustworthy AI.

NIST's actions under the President's Executive Order 14110 and its new U.S. AI Safety Institute are major initiatives designed to dramatically advance the ability to measure and evaluate the trustworthiness of rapidly advancing AI technologies. While NIST's activities have typically addressed measures of accuracy and robustness, other types of AI-related measurements and evaluations under investigation include safety, bias, interpretability, and transparency. Working with others, NIST aims to augment such efforts by:

- *Advancing measurement science for AI:* Defining, characterizing, and theoretically and empirically developing and analyzing quantitative and qualitative metrics and measurement methods for various characteristics of AI technologies.
- *Conducting rigorous evaluations of AI:* Designing and conducting evaluations of AI technologies – including developing tasks, challenge problems, testbeds, software tools, and helping to curate and characterize meaningful data sets – and identifying technical gaps and limitations in AI technologies and related measurements.
- *Developing best practices and technical guidance:* Sharing results and guidance to inform academic, industrial, and government programs.
- *Contributing to voluntary consensus-based AI standards for measuring and evaluating AI:* Leading or participating in standardization efforts to support the development, deployment, and evaluation of AI technologies.

## Lead and Participate in Development of Technical AI Standards

NIST leads and participates in the development of technical standards, including international standards, that promote innovation and public trust in systems that use AI.

### Global Engagement for AI Standards

- Under the October 30, 2023, Presidential Executive Order, NIST is developing a plan for global engagement on promoting and developing AI standards. The goal is to drive the development and implementation of science-backed AI-related consensus standards, cooperation and coordination, and information sharing.

### Ensuring Awareness and Federal Coordination in AI Standards Efforts

- In its role as federal AI standards coordinator, NIST works across the government and with industry to identify critical standards development activities, strategies, and gaps. Based on priorities outlined in the NIST- developed Plan for Federal Engagement in AI Standards and Related Tools, the agency is tracking AI standards development opportunities, periodically collecting and analyzing information about agencies' AI standards-related priority activities, and making recommendations through interagency processes to optimize engagement.
- NIST is coordinating federal agencies in the development and use of AI standards in part through the Interagency Committee on Standards Policy (ICSP), which it chairs. ICSP's AI Standards Coordination Working Group promotes effective and consistent federal policies to leverage and further development of AI standards, raise awareness, and foster agencies' use of AI.

### Participating in High-Priority AI Standards Activities

- NIST supports its staff's participation and leadership in standards development activities aligned with NIST technical expertise.
- NIST efforts include work through two prominent international standards developing organizations: ISO and IEEE.

## Contribute Technical Expertise to Discussions and Development of AI Policies

NIST provides scientific and technical expertise and is helping national and global AI policy bodies shape the development and use of innovative, trustworthy AI. In the international arena, standards are a critical element of government's AI policies and industry practices. NIST plays a key role as a neutral convener of organizations and individuals with disparate views about AI matters.

### Contributing to Federal Engagements that Explore or Determine AI-Related Policies

- NIST leads or participates in several federal AI policymaking efforts and engages with many other federal offices and interagency groups. This includes administering the National Artificial Intelligence Advisory Committee, co-chairing the National Science and Technology Council's Machine Learning and Artificial Intelligence Subcommittee, co-chairing the Networking and Information Technology Research and Development's AI Working group, and founding and co-chairing the AI Standards Coordination Working Group under the Interagency Committee Standards Policy. NIST's AI lead also serves as Federal AI Standards Coordinator and was a member of the National AI Research Resource Task Force.

### Participating in Major AI Forums

- NIST engages with private, public, and non-profit organizations – directly and via international forums and other dialogues – about AI-related policies that align with NIST's mission and technical contributions. NIST also convenes national and international stakeholders to ensure two-way communication on select AI-related issues.
- NIST is heavily engaged with US and international AI policy efforts such as the US-EU Trade and Technology Council, OECD, Global Partnership on AI, Council of Europe, Quadrilateral Security Dialogue, and a host of bilateral initiatives in Asia, Europe, the Middle East, and North America. NIST partners with other agencies, including the US Department of Commerce's International Trade Administration and the US Department of State on many of these efforts.

## Engage with NIST



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