Artificial Intelligence: A NIST strategic priority

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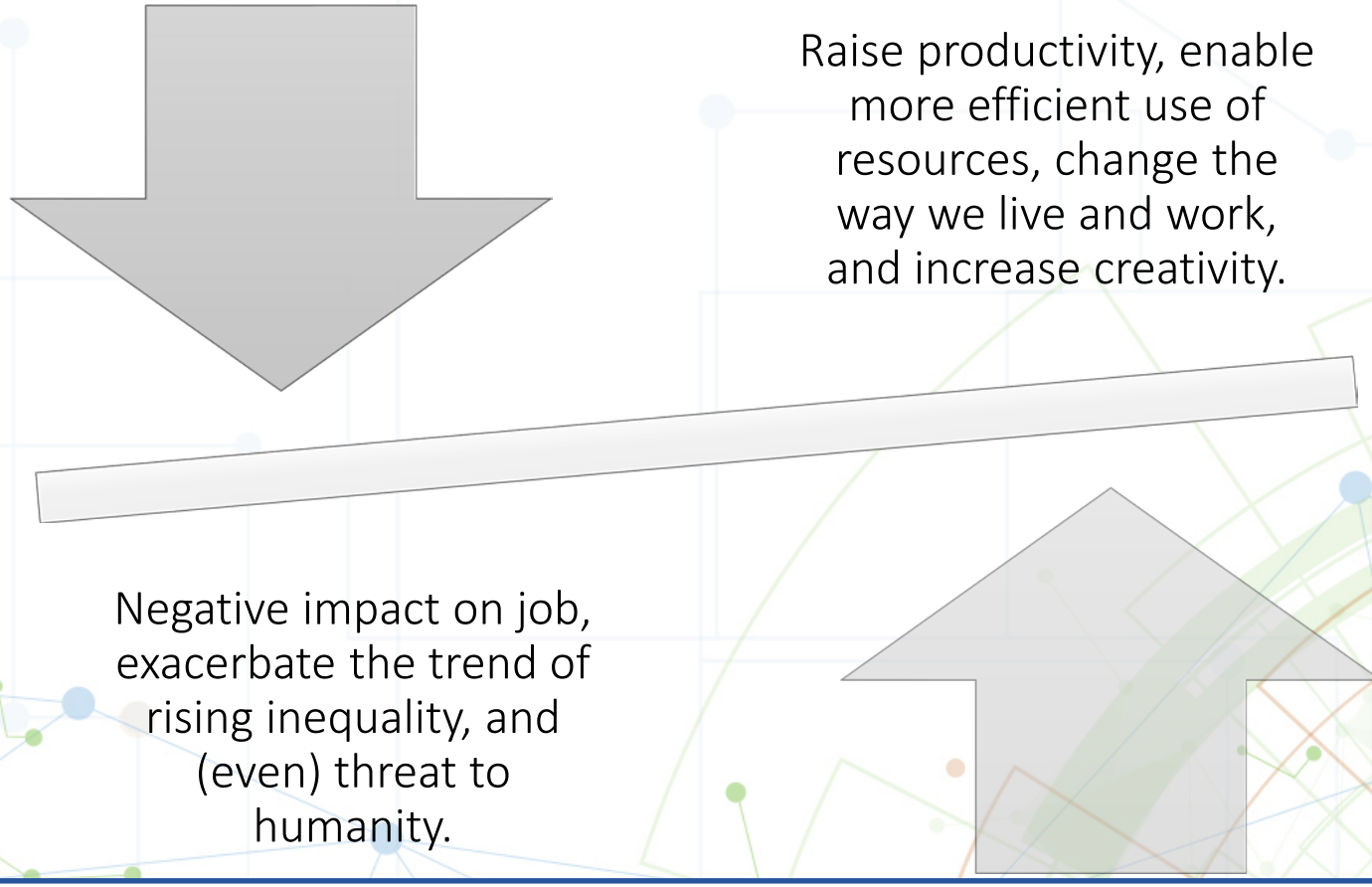
National Institute of Standards and Technology
U.S. Department of Commerce

Major advances in artificial intelligence



Raise productivity, enable more efficient use of resources, change the way we live and work, and increase creativity.

Negative impact on job, exacerbate the trend of rising inequality, and (even) threat to humanity.

NIST will become an authoritative source of measurement tools, capabilities, and data necessary to define, develop, and evaluate Trustworthy AI.

Fundamental	Applied
Measure and enhance the trustworthiness of AI systems.	Revolutionizing metrology at NIST from experiment design to research results.

From innovation to application

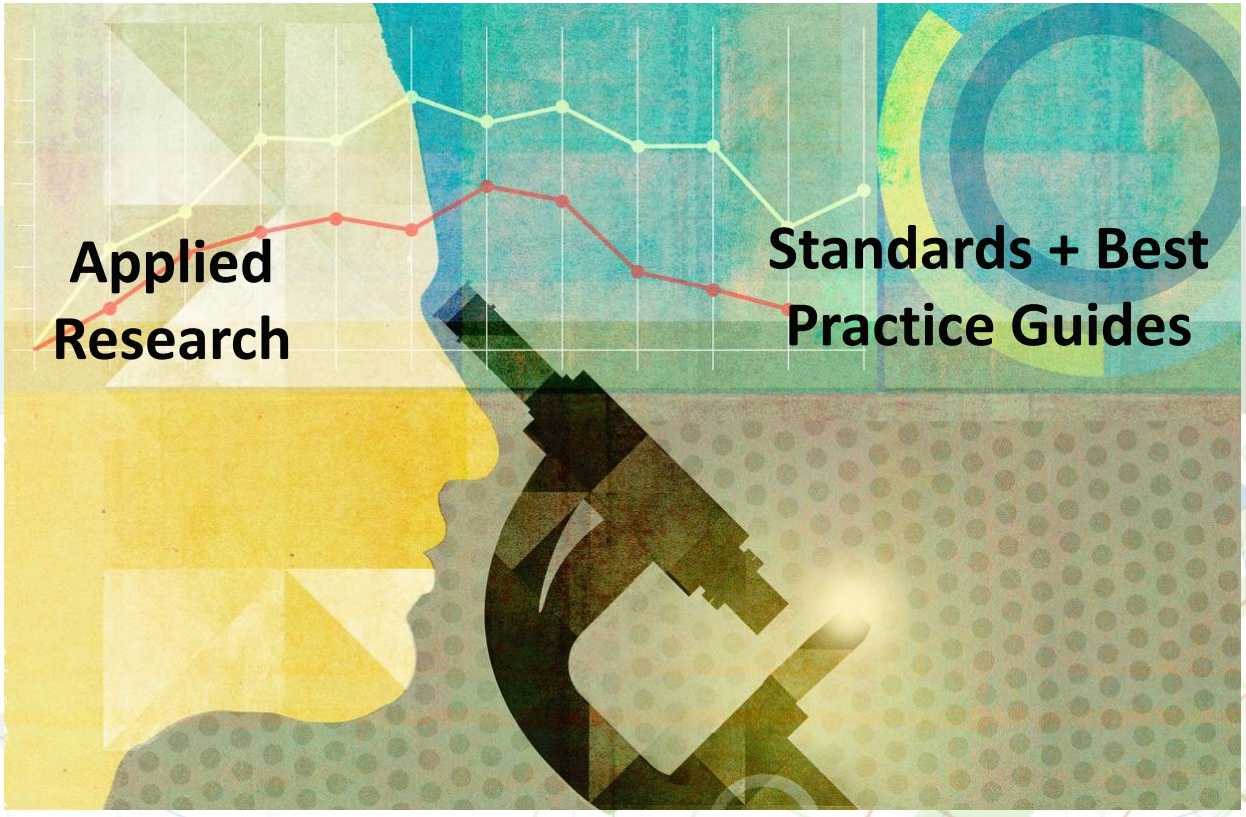


Image Credit: wsj.com

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Coordination Activities

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Interagency coordination and leadership

AI Select Committee
Chaired by OSTP, NSF, DARPA

Office of Science and Technology Policy

NSTC

MLAI Subcommittee
Chaired by NIST, OSTP, DoE

USG AI Standards Coordinator

Networking and Information Technology R+D (NITRD)

AI Interagency Working Group

National Security Commission on AI
Chief Technical Advisor

Collaboration with other agencies

Joint AI Center

National Institute of Standards and Technology
U.S. Department of Commerce

Federal Engagement in Artificial Intelligence Standards

EO on Maintaining American Leadership in AI

EXECUTIVE ORDERS

Executive Order on Maintaining American Leadership in Artificial Intelligence

INFRASTRUCTURE & TECHNOLOGY | Issued on: February 11, 2019

www.whitehouse.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/

Within 180 days…

Secretary of Commerce, through Director of NIST, shall issue a plan for Federal engagement in the development of technical standards and related tools in support of reliable, robust, and trustworthy systems that use AI technologies.

By the Numbers

97
RFI RESPONSES

>400
WORKSHOP ATTENDEES

6
BREAKOUT SESSIONS

43
PUBLIC COMMENTS

2
DOCUMENTS

10
AUGUST

10

Recommended Actions

Coordination

Bolster AI standards-related knowledge, leadership, and coordination among Federal agencies to maximize effectiveness and efficiency.

Research

Promote focused research to accelerate broader exploration and understanding of how aspects of trustworthiness can be practically incorporated within standards.

Partnership

Support and expand public-private partnerships to develop and use AI standards and related tools to advance trustworthy AI.

Engagement

Strategically engage with international parties to advance AI standards for U.S. economic and national security needs.

Trustworthy AI

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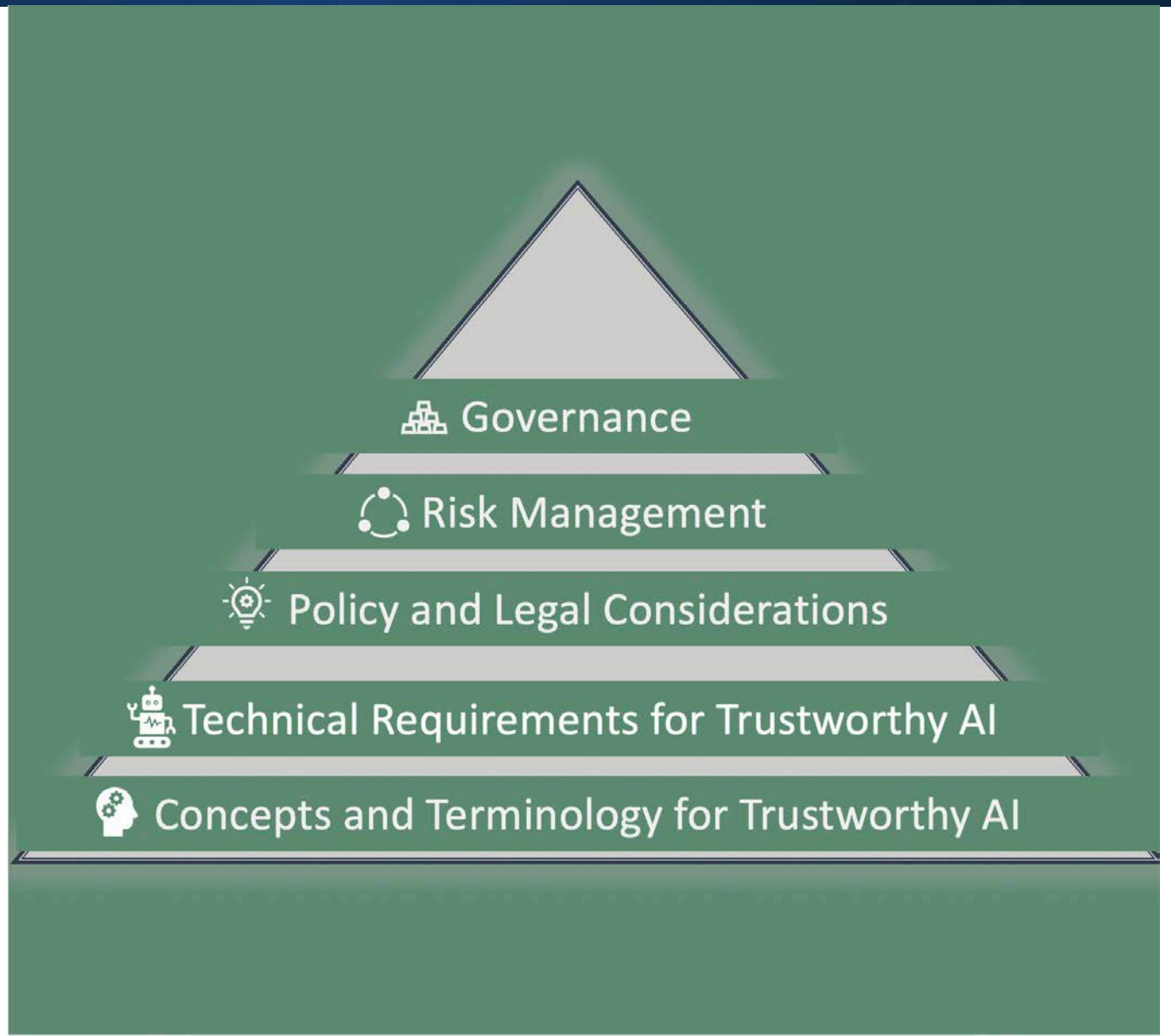
Foundational research for trustworthy AI



Technical requirements for trustworthy AI

accurate

secure

robust

explainable

objective

reliable

and more …

Secure AI

Terminology and Taxonomy of attacks and defenses for Adversarial Machine Learning. Testbed for secure AI.

NCCoE
NATIONAL CYBERSECURITY CENTER OF EXCELLENCE

Collaboration with MITRE. IARPA, DARPA, and DoD JAIC.

Draft NIST IR 8269: Terminology and Taxonomy

Testbed to evaluate AI vulnerabilities.

Explainable AI

Forms the bases of addressing bias, transparency, security, safety and ultimately trust in AI systems.

Developed principles of explainable AI.

Socializing with experts in the community.

Draft for public comment planned for Spring 2020.

Bias in AI

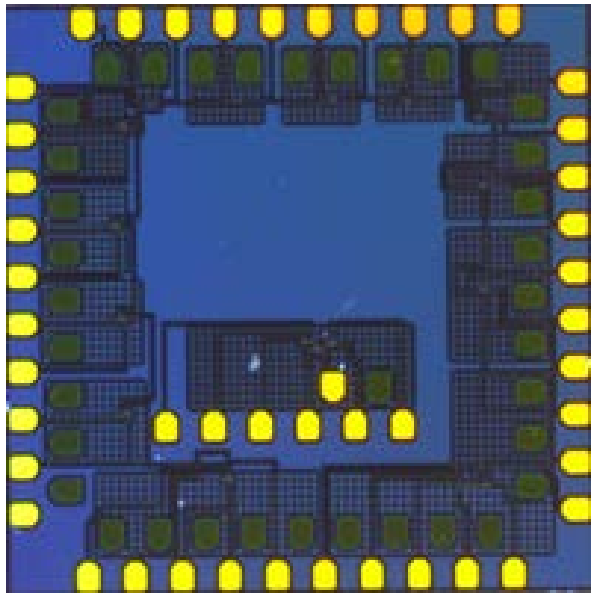
Define, identify, measure and mitigate bias in AI systems.

Touch points of bias throughout AI development life cycle.

Workshop in Summer 2020.

Publication for public comment Fall 2020.

Novel computational paradigms for AI



Schneider, M.L., Donnelly, C.A., Haygood, I.W. et al. Synaptic weighting in single flux quantum neuromorphic computing. Sci Rep 10, 934 (2020)

- Establishing metrics and benchmarks for AI hardware.
- Foundational analysis of the computational capacity of a physical system.
- Analysis and development of algorithms for spike-based computation.

AI at NIST: Spectrum sharing

Top 6 NIST News Story in 2019

Citizens Broadband Radio Service (3.55 – 3.7 GHz) for mobile broadband use.

- Current incumbents include Navy, satellite service providers and utilities.
- Incumbent signals are detected using automated detectors that look for energy rises in the electromagnetic spectrum, but these detectors (ESC) are not consistently discriminating enough, sometimes confusing other RF signals as radar or missing the radar signals altogether

Outcome

- 10 standards for service providers (Bronze Medal)
- NIST developed AI algorithms for more efficient detection of offshore radar signals relying on NASCTN spectrograms
- AI methods significantly more effective than energy detection (ESC)

Impact

- Revised occupancy statistics ➔ greater accessibility for commercial providers (2 hrs ➔ 20 mins)
- May allow for more users and increase valuation of spectrum licenses.
- NIST developing curated data sets for industry use.

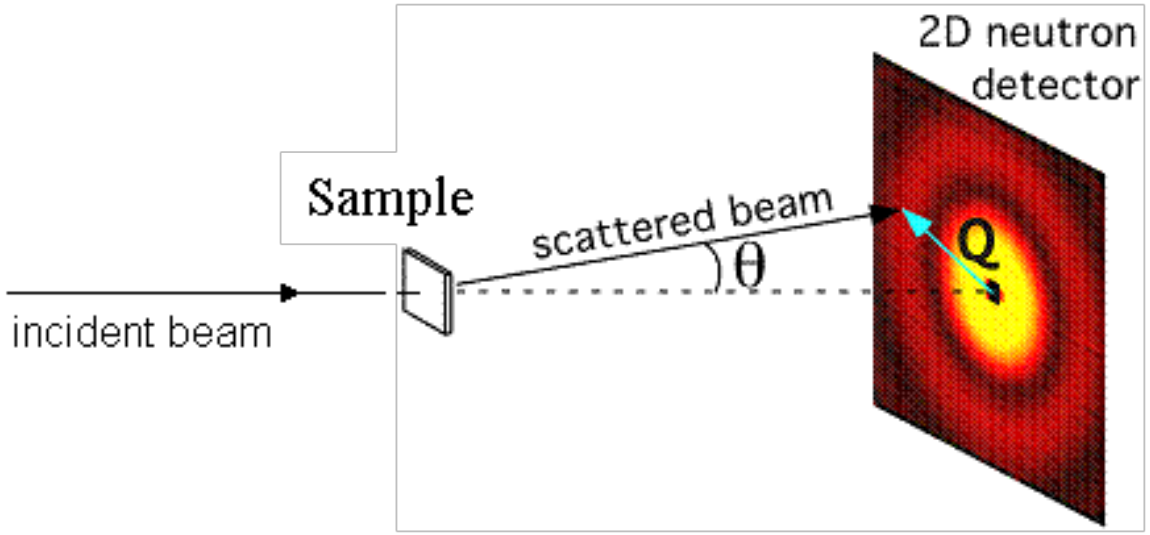
https://www.nist.gov/programs-projects/35-ghz-spectrum-sharing

AI at NIST: Advanced materials discovery

Creating a high-fidelity database, Joint Automated Repository for Various Integrated Simulations, density functional theory (JARVIS-DFT), with more than 30,000 materials and 500,000 properties to be used as training data.

https://jarvis.nist.gov/

AI at NIST: Small angle neutron scattering

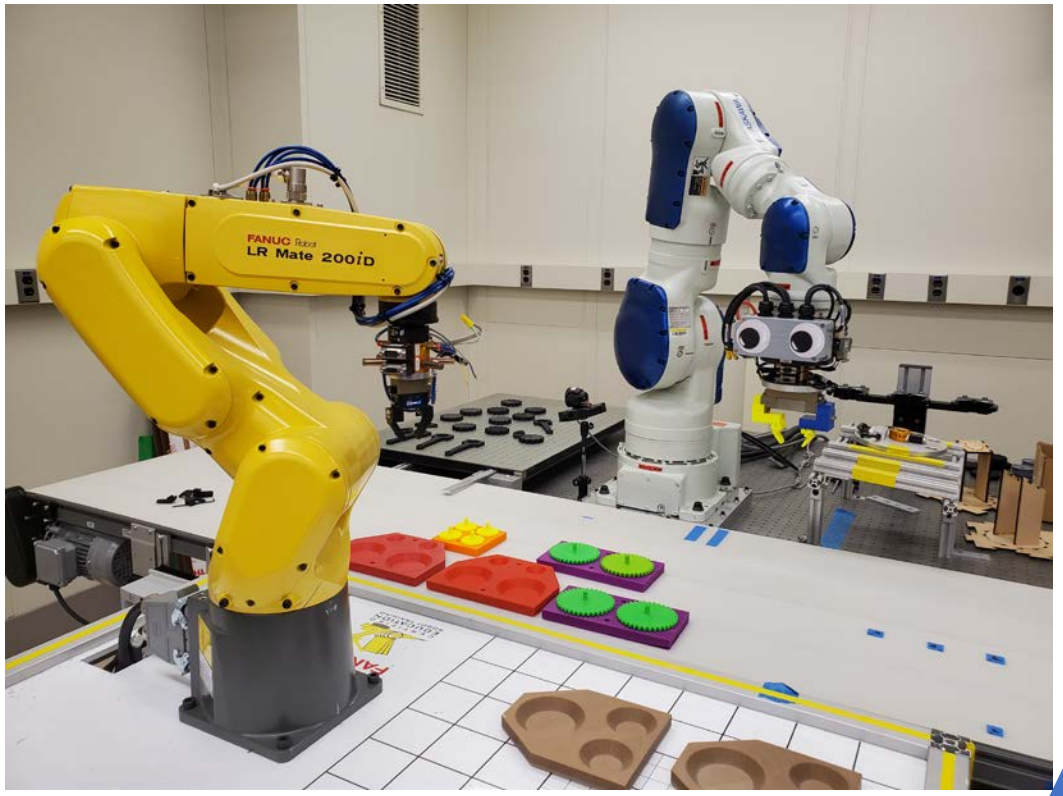


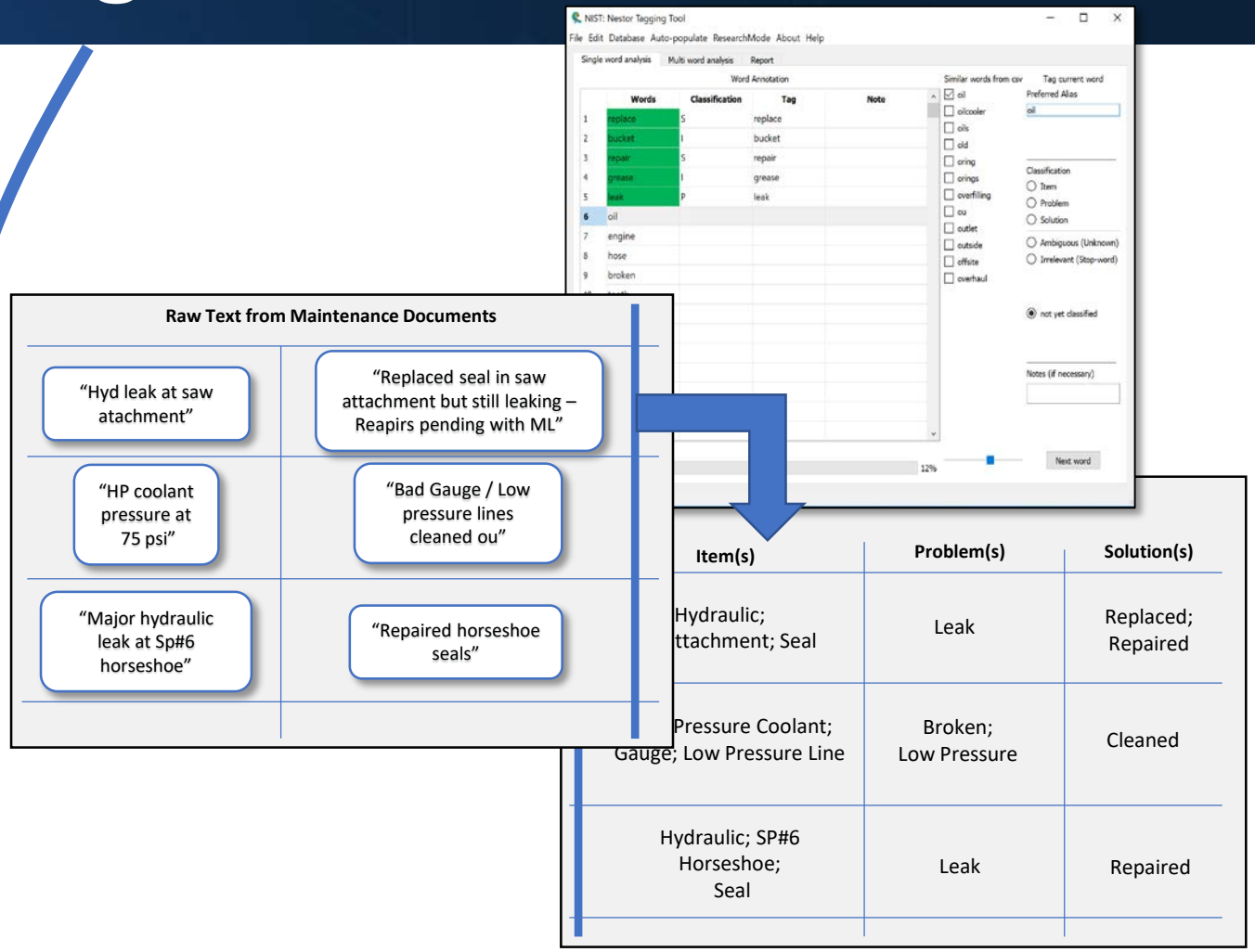
Creation of reference datasets for Small Angle Neutron Scattering (SANS) for machine learning applications as well as Neutron Instrument Automation through AI and Automatic Phase Diagram Mapping for Liquid Formations.

https://www.nist.gov/ncnr/neutron-instruments/small-angle-neutron-scattering-sans

AI at NIST: Manufacturing

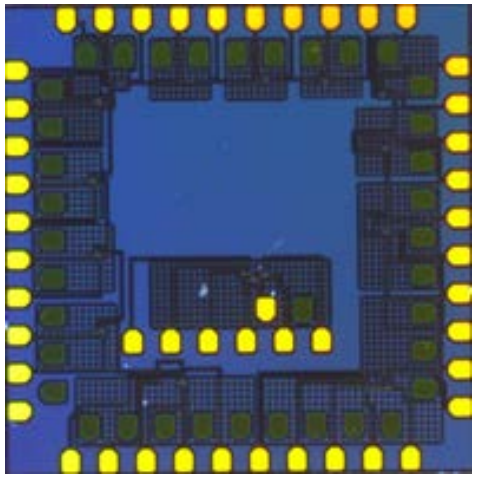
Agile Robotics for Industrial Automation Competition (ARIAC)





"Nestor" – Natural language processing toolkit for manufacturing documents

AI at NIST: Neuromorphic computing



Simulation of a self-training single-flux-quantum neural network

Successful simulation of a fanout of 1-to-1,024 and fan-in of 1-to-256 at NIST. Although short of the human brain, it brings the technology in line with silicon neuromorphic computing. The fan-in of 256-to-1 is the same level that was used in the IBM True North chips.

https://www.nist.gov/publications/energy-efficient-single-flux-quantum-based-neuromorphic-computing

Planned Efforts

Our plan

To support the responsible design, development, and use of trustworthy AI

Foundational AI research

Revolutionizing metrology across NIST

Launching an AI resource center for use by NIST researchers and industry

In the coming year

Foundational Research

AI for Metrology

AI Hardware

AI Standards

Data and Tools

AI workshops

QUESTIONS?