



NARUC Innovation Webinar

Powering the Future: Transforming Energy Distribution with Artificial Intelligence

December 14, 2023 | 3:00-4:00pm (ET)

NARUC thanks the U.S. Department of Energy for its support of this event.

ABOUT NARUC

- The National Association of Regulatory Utility Commissioners (NARUC) is a non-profit organization founded in 1889.
- Our Members are the state utility regulatory Commissioners in all 50 states & the territories. FERC & FCC Commissioners are also members. NARUC has Associate Members in over 20 other countries.
- NARUC member agencies regulate electricity, natural gas, telecommunications, and water utilities.



NARUC'S CENTER FOR PARTNERSHIPS & INNOVATION

Background & Focus

- NARUC staff dedicated to providing technical assistance to members.
- CPI identifies emerging challenges and connects state commissions with expertise and strategies to inform their decision making.
- CPI builds relationships, develops resources, and delivers trainings.
- All CPI support is federally funded via cooperative agreements with DOE and NIST.



Newly updated CPI fact sheet with recent publications, upcoming events, new member working groups located under Quick Links at:
www.naruc.org/cpi

NARUC Center for Partnerships & Innovation

Identifying emerging challenges and connecting state commissions with expertise and strategies to navigate their complex decision-making



The NARUC Center for Partnerships & Innovation (CPI) builds relationships, develops resources, and delivers training to assist state commissions with complex current and emerging issues. CPI is funded by cooperative agreements with the U.S. Department of Energy (DOE) and the U.S. Department of Commerce's National Institute of Standards and Technology (NIST). CPI works across five key areas:

Energy Generation	Energy Transmission	Energy Distribution	Energy Customers
<ul style="list-style-type: none">Coal & Carbon Management*Nuclear Energy*Natural Gas*HydrogenOff-Shore WindUtility-Scale Renewables	<ul style="list-style-type: none">Transmission InfrastructureTransmission-Distribution Coordination*StorageComprehensive Electricity Planning	<ul style="list-style-type: none">Integrated Distribution PlanningGrid ModernizationMicrogrids*Performance-Based Regulation*Virtual Power Plants	<ul style="list-style-type: none">DER Integration & Compensation*Demand Flexibility*Electric Vehicles*Stakeholder EngagementEnergy Justice

Contact Kiera Zitelman

Contact Jeffrey Laiter

Contact Lynn Cosentino

*Contact us to join a members-only group on this topic for regular learning and peer exchange opportunities.

Sign up for the CPI Newsletter for monthly updates about new resources and forthcoming events.

The NARUC CPI team looks forward to engaging with NARUC's members throughout the year—your needs drive our priorities and activities. Reach out at any time!

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NARUC CPI is hiring! Please contact us to learn more about exciting new opportunities.

www.naruc.org/cpi | Last updated February 2023

Recent Publications

- Demand Flexibility within a Performance-Based Regulatory Framework (Feb 2023)
- State Energy Justice Roundtable Series- Customer Affordability and Affordability: Participation in Decision-Making: Energy Justice Metrics (Feb 2023)
- Mini Guide on PUCs and the Investment Community (Feb 2023)
- Energy Resilience Reference Guide, Chapters 1 & 2 (Jan & Feb 2023)
- Potential State Regulatory Pathways to Facilitate Low-Carbon Fuels (Dec 2022)
- Digitalization in Electric Power Systems and Regulation: A Primer (Dec 2022)
- Interoperability for Electric Vehicle Charging: A Case Study (Dec 2022)
- Electric Vehicle Interoperability: Considerations for Utility Regulators (Nov 2022)
- Models for Incorporating Equity in Transportation Electrification (Nov 2022)
- Mini Guide on Transportation Electrification (Nov 2022)
- Grid Data Sharing: Brief Summary of Current State Practices (Nov 2022)
- Regulator's Financial Toolbox Briefs: Community Solar for LMI Customers; Electrification: ADMS/DERMS (Oct 2022)
- Defense Energy Resilience Resources Guide & FAQ for Commissioners (Oct 2022)
- Workforce Development Toolbox, Recruitment Templates and Social Media Engagement Materials (Sept 2022)

- ### Forthcoming Publications
- Black Sky Playbook
 - Energy Resilience Reference Guide Chapter 3: Climate Resilience
 - State Microgrid Policy, Programmatic, and Regulatory Framework
 - Renewable Energy Microgrids
 - Considerations of Advanced Nuclear in Resource Planning

Upcoming Virtual Learning Opportunities

- Modern DER Capabilities and Deployment. March 8: Next in the virtual interconnection workshop series, NREL will address PUC questions on DER technical capabilities, deployment concerns, and benefits. Contact Jeff
- Resilience for Regulators Webinar Series. March 9: Climate Informed Mitigation Strategies. Find past presentations on critical infrastructure resilience, climate resilience, defense energy resilience, and more. Contact William
- Monthly Innovation Webinars. March 16: Advances in Resource Adequacy. Register | past recordings. Contact Jessica
- On-Demand, Video-Based Learning Modules: Dozens of training videos in English and Spanish on electricity system planning, distribution systems and planning, smart grid and EV interoperability. Contact Danielle

Upcoming In Person Events Travel stipends available

- Cybersecurity Training, Indianapolis, IN. March 22-24: Experts will provide content on cybersecurity topics through the lens of utility regulators with presentations, engaging activities, and more. (Commissioners and staff) Contact Jessica
- Nuclear Energy Partnership Pacific Northwest National Lab Site Visit. April 25-28: Tour PNNL and NW nuclear sites. Advanced Nuclear State Collaborative kickoff workshop will also take place. (Commissioners and staff) Contact Kiera
- Natural Gas Partnership Site Visit, Savannah, GA. May 2023: Tour the Elba Island liquefied natural gas export facility. Port of Savannah compressed natural gas fueling station, and more. (Commissioners only) Contact Kiera
- More Info Available Soon: Energy Justice Midwest Regional Workshop (early May); Grid Data Sharing Collaborative Demonstration Workshop (mid-May in Washington, DC); Resilience Planning Regional Workshops Contact Danielle

Join a Member Working Group! For Commissioners and Commission Staff

- Integrated Distribution System Planning. Register for presentations by subject matter experts and commissions followed by questions and facilitated discussions among members. Six sessions: Feb 27 - Jun 12. Contact Jeff
- NARUC-NASEO Advanced Nuclear State Collaborative. Exchange questions, needs, and challenges relating to the planning and deployment of new advanced nuclear generation. Contact Kiera
- NARUC-NASEO Microgrids State Working Group. Explore capabilities, costs, benefits, and deployment strategies for microgrids with PUCs and State Energy Offices. Contact Kiera
- Electric Vehicles State Working Group. Learn and discuss regulatory questions around transportation electrification, including charging infrastructure buildout, rate design, equity considerations, V2G, and more. Contact Danielle
- Performance-Based Regulation State Working Group. Examine approaches to performance-based regulation and alternative ratemaking across states in a collaborative peer group setting. Contact Elliott
- 2X Working Groups. DOE/National Lab effort for commissions and stakeholders to identify grid interconnection challenges and discuss solutions. Contact Jeff
- Workforce Development Peer Advisory Group. Supporting recruitment & retention for commissions. Contact Hyleah

www.naruc.org/cpi | Last updated February 2023



NARUC Innovation Webinar

Powering the Future: Transforming Energy Distribution with Artificial Intelligence

Moderator: **Hon. Mary Anna Holden** – Commissioner, New Jersey Board of Public Utilities

- **Lew Folkerth** – Principal Reliability Consultant, Reliability First
- **David Larson** – Technical Leader, Grid Ops & Planning, EPRI
- **Thomas O'Brien** – Senior Vice President, and Chief Information Officer, PJM Interconnection
- **Raiford Smith** – Chief Utility Innovation Officer, AES



What is AI?

NARUC Innovation Webinar

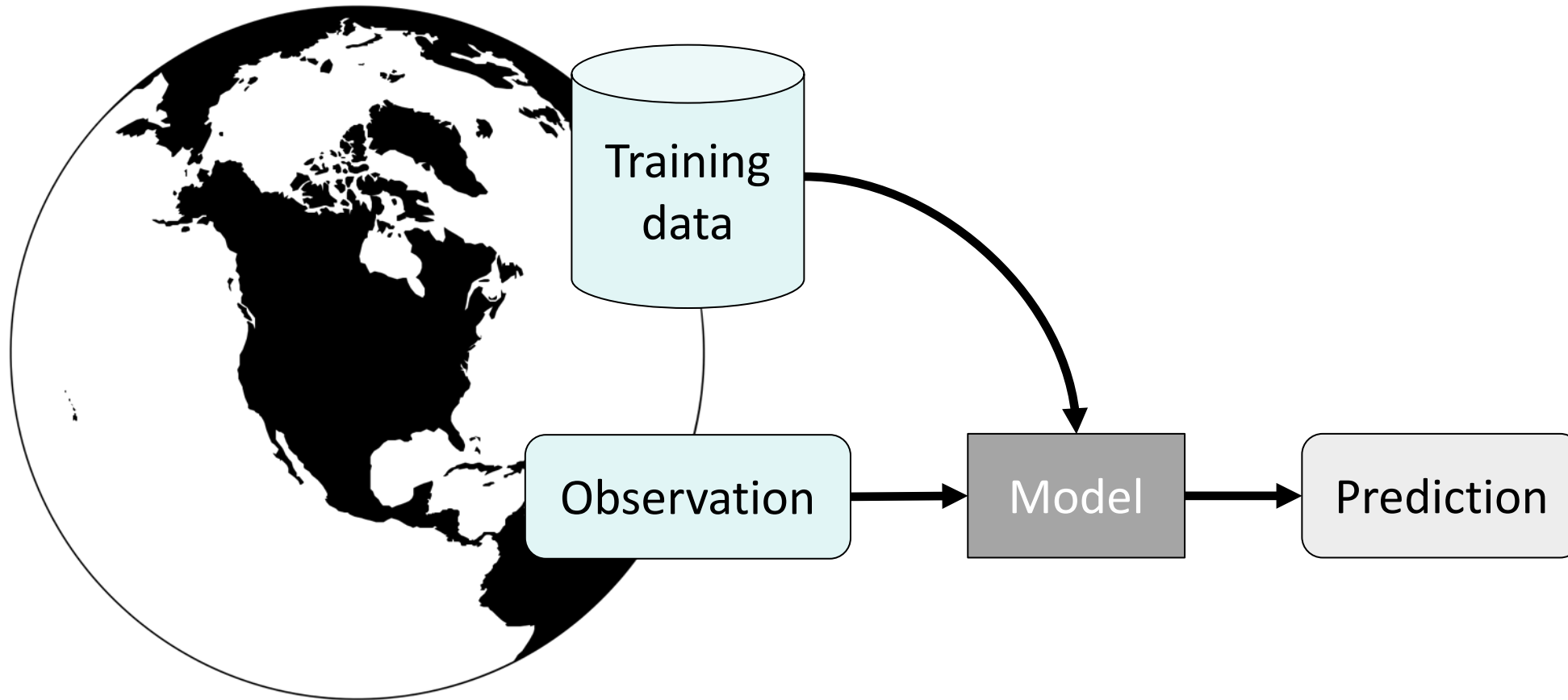
David Larson, PhD
Technical Leader
Grid Operations & Planning
dlarson@epri.com



December 14, 2023

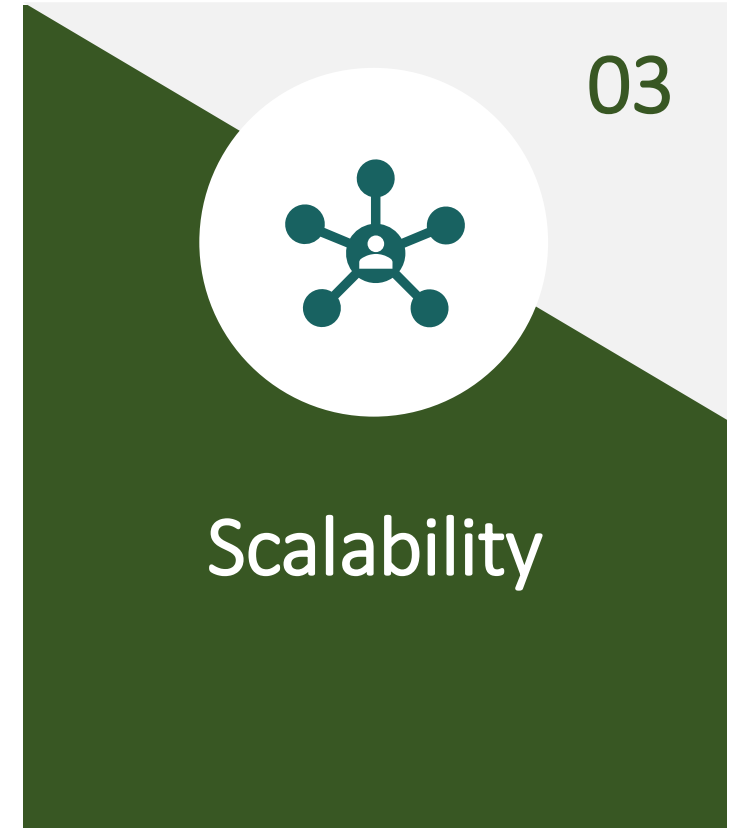
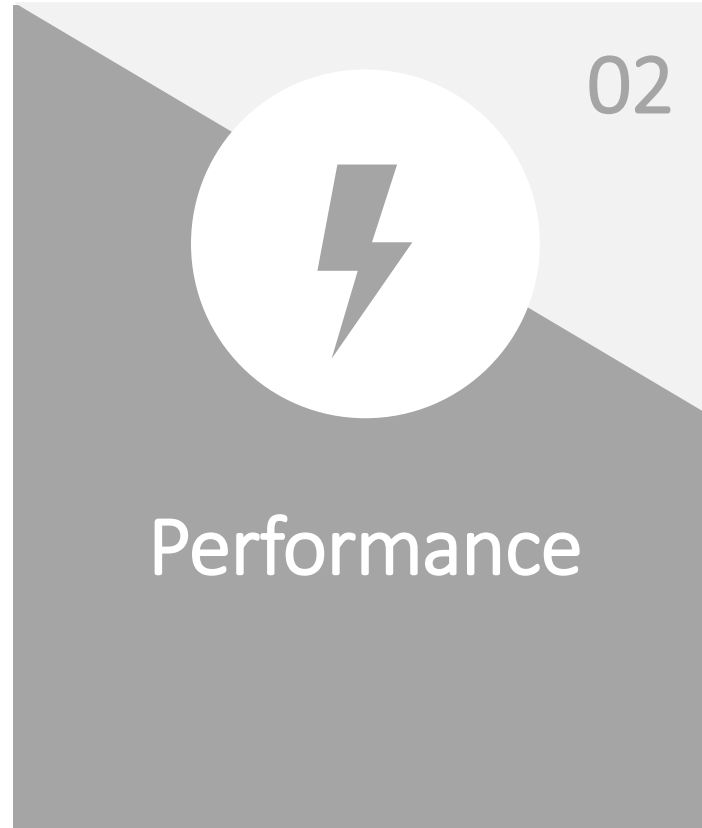


What is Artificial Intelligence (AI)?



*diagram inspired by Prof. Sarah Dean, Cornell: <https://sdean.website/>

Why AI for energy applications?



A blue-tinted photograph of four people standing in a row. From left to right: a man with curly hair and glasses in a white lab coat; a man with glasses in a white lab coat; a woman wearing a hard hat and a dark polo shirt; and a man with glasses and a beard in a light blue button-down shirt. The text 'Together...Shaping the Future of Energy®' is centered over the image.

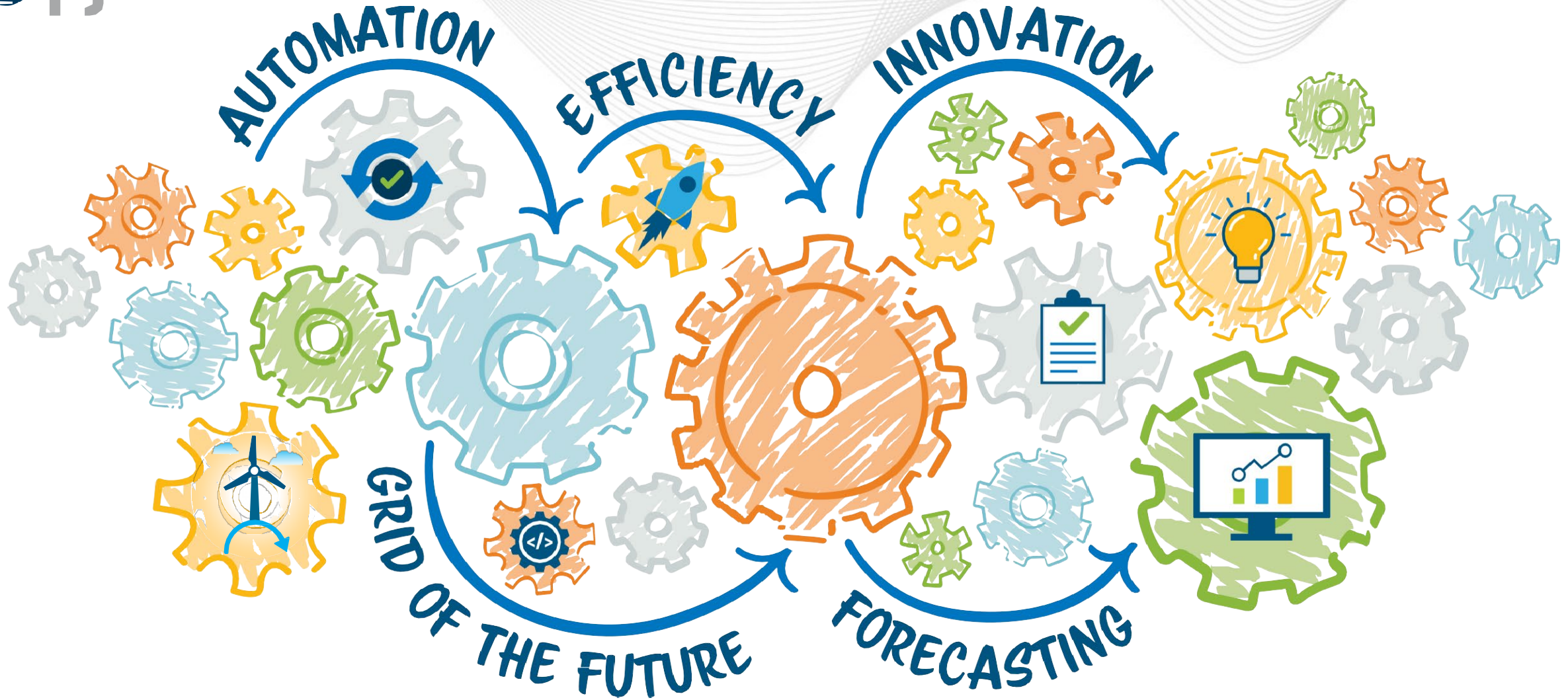
Together...Shaping the Future of Energy®



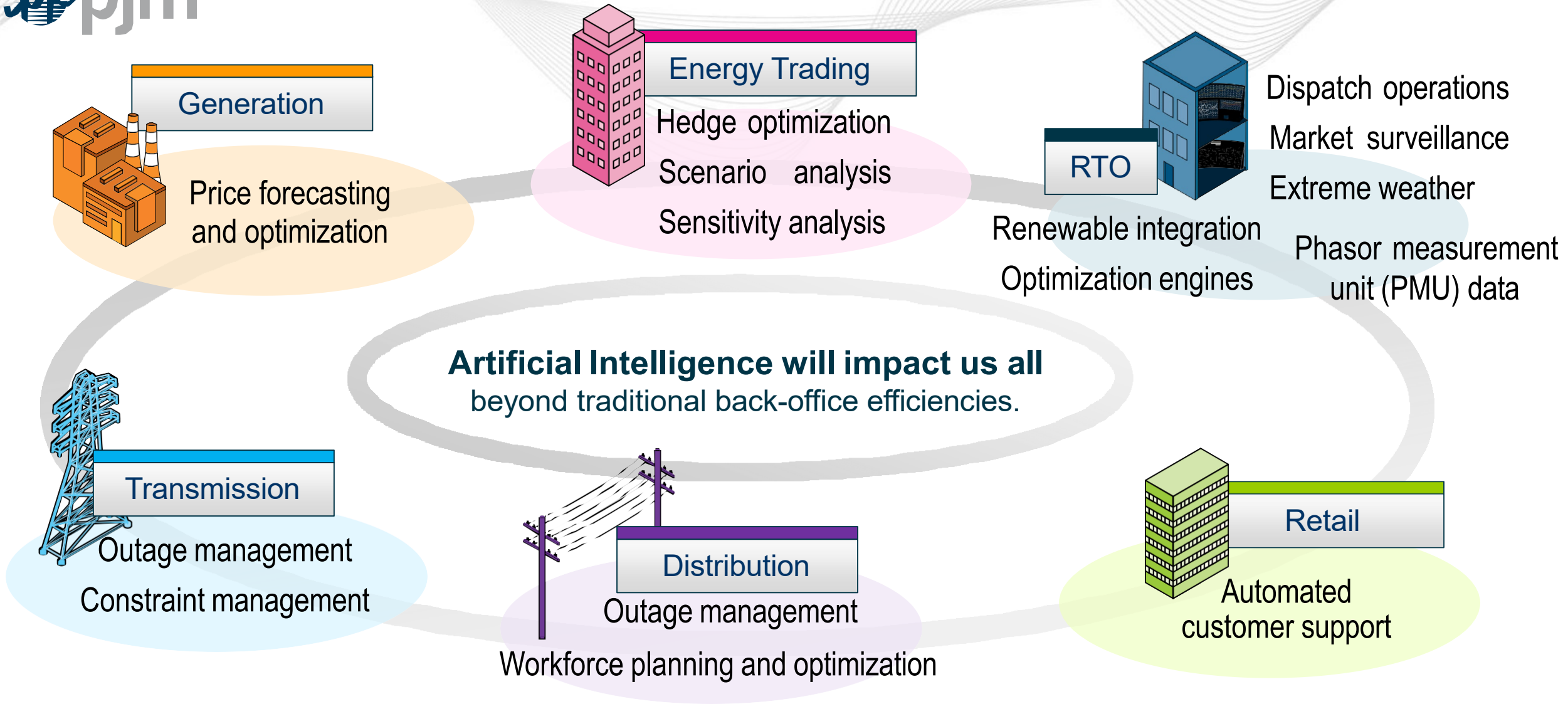
Innovation Webinar

Powering the Future: Transforming Energy Distribution With Artificial Intelligence

Thomas F. O'Brien
PJM Interconnection
Sr. Vice President and CIO
December 14, 2023



Reimagining Operational Tools – Use Cases



Key Success Factors

Quality data

Controls and governance

Experimentation

Strategic priorities

Skills development

Strong partnerships

Human engagement

THREATS



Algorithms gone wrong

General Risks

Liability

Explainability

Trust

Regulatory risk

Workforce impacts

Legal copyright challenges

Bias

Confidential data

AI AND OPERATIONAL TECHNOLOGY

Lew Folkerth

Principal Reliability Consultant

Reliability First

AI AND OPERATIONAL TECHNOLOGY

- The threat so far (still early)
 - No new concepts - enhancement of attackers' skills, not new skills
- External AI impact
 - Increased sophistication
 - Increased speed
 - Lowering attacker's learning curve
 - Security and privacy overlap
- Internal AI impact
 - Doesn't need aggressor - internal leaks can cause significant risk

AI DEFENSES

- Asset identification
 - Don't let your attacker have a better network diagram than you have
- Asset isolation
 - Never expose operational assets directly to the Internet - (SHODAN)
 - Or even to your corporate network
 - Internal segmentation
 - Strong authentication - multi-factor
 - Basic security hygiene - change default passwords, etc.

AI DEFENSE - FUTURE PLANNING

- Incident response will be even more important
 - Focus on rapid response
 - Improved training regimen
 - More frequent exercises
- Threat monitoring
 - Keep tabs on what is happening
 - Expect new AI-based threats
 - Develop resources to assist in threat monitoring

Artificial Intelligence and the Utility Industry



- **Raiford Smith**
- Chief Utility Innovation Officer
- AES Utilities
- December 14, 2023

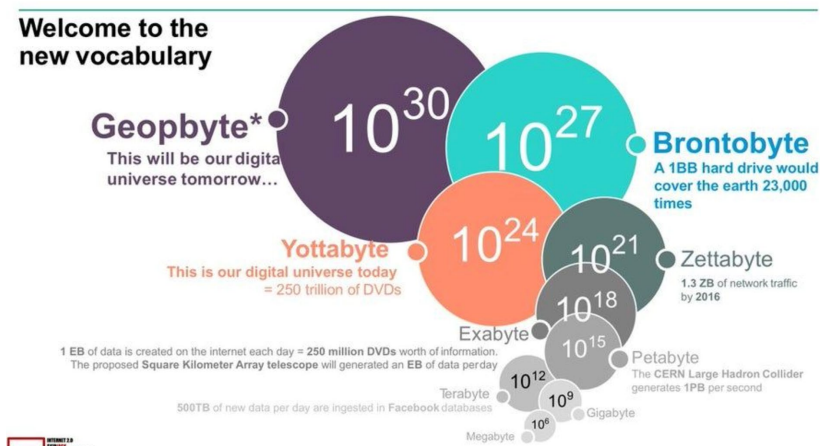
Historical Limitations to Solving Complex Problems



COMPUTE



DATA



Dependent Variable

Population Y intercept

Population Slope Coefficient

Independent Variable

Random Error term

$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i$$

Linear component

Random Error component

MATHEMATICS

Quanta magazine

Physics Mathematics Biology Computer Science Topics Archive

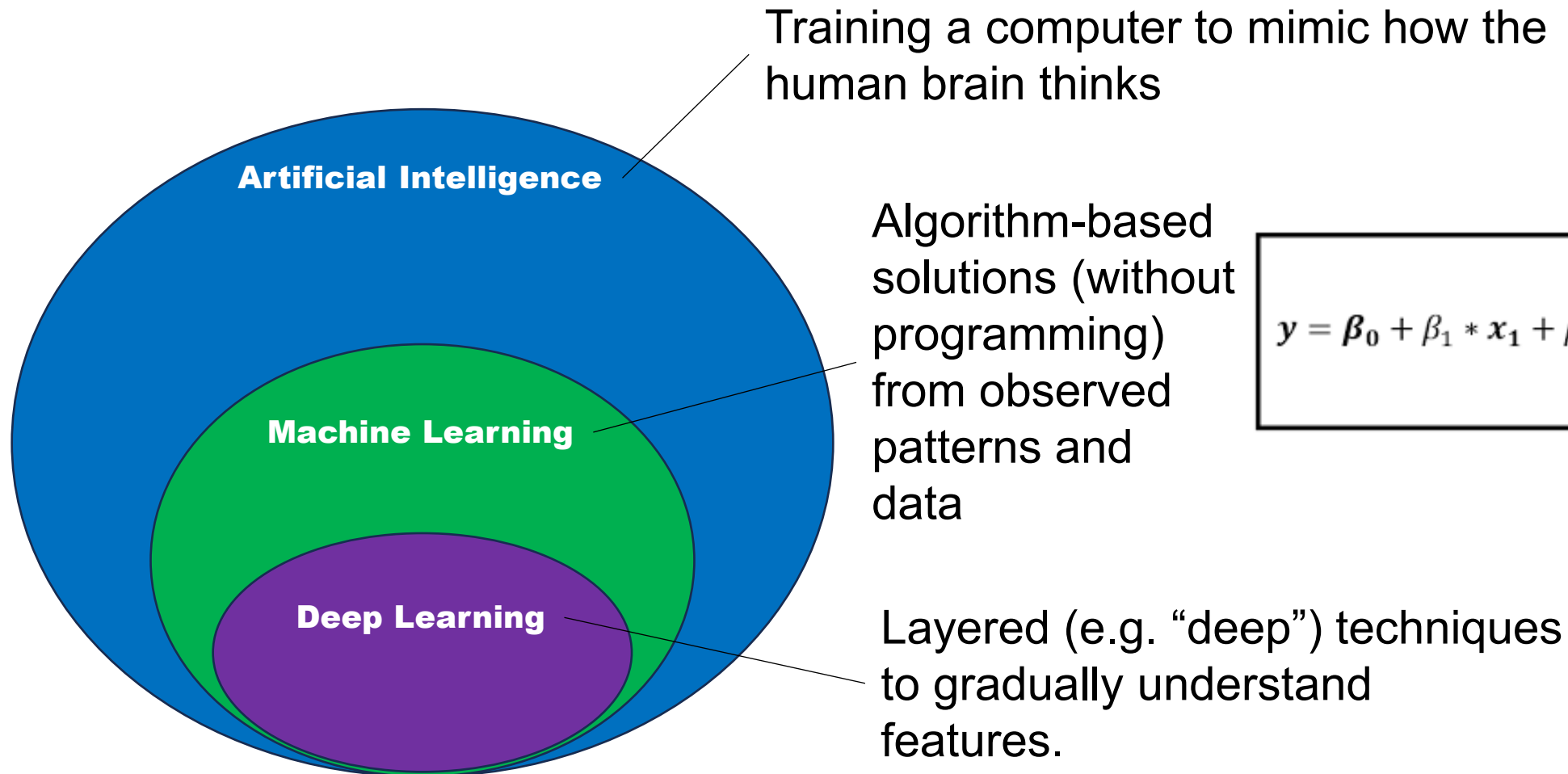
COMPUTATIONAL COMPLEXITY

Computer Scientists Inch Closer to Major Algorithmic Goal

A new paper finds a faster method for determining when two mathematical groups are the same.

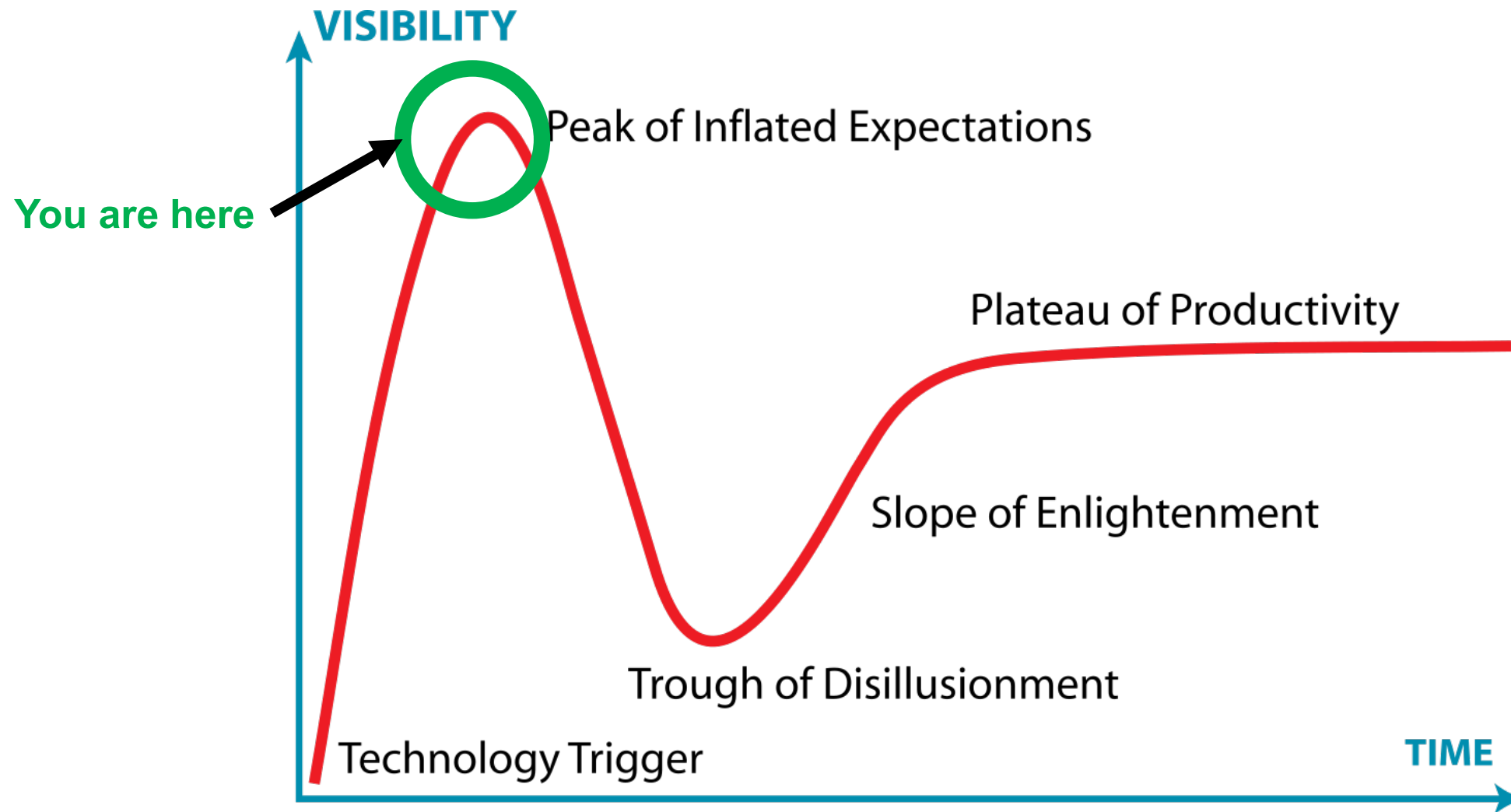
A screenshot of a Windows desktop environment, showing various application icons on the taskbar and a background image of a landscape with a tree and a building.

Defining Artificial Intelligence (AI)



$$y = \beta_0 + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \dots + \beta_p * x_p$$





Defining Artificial Intelligence (AI)

NARROW INTELLIGENCE



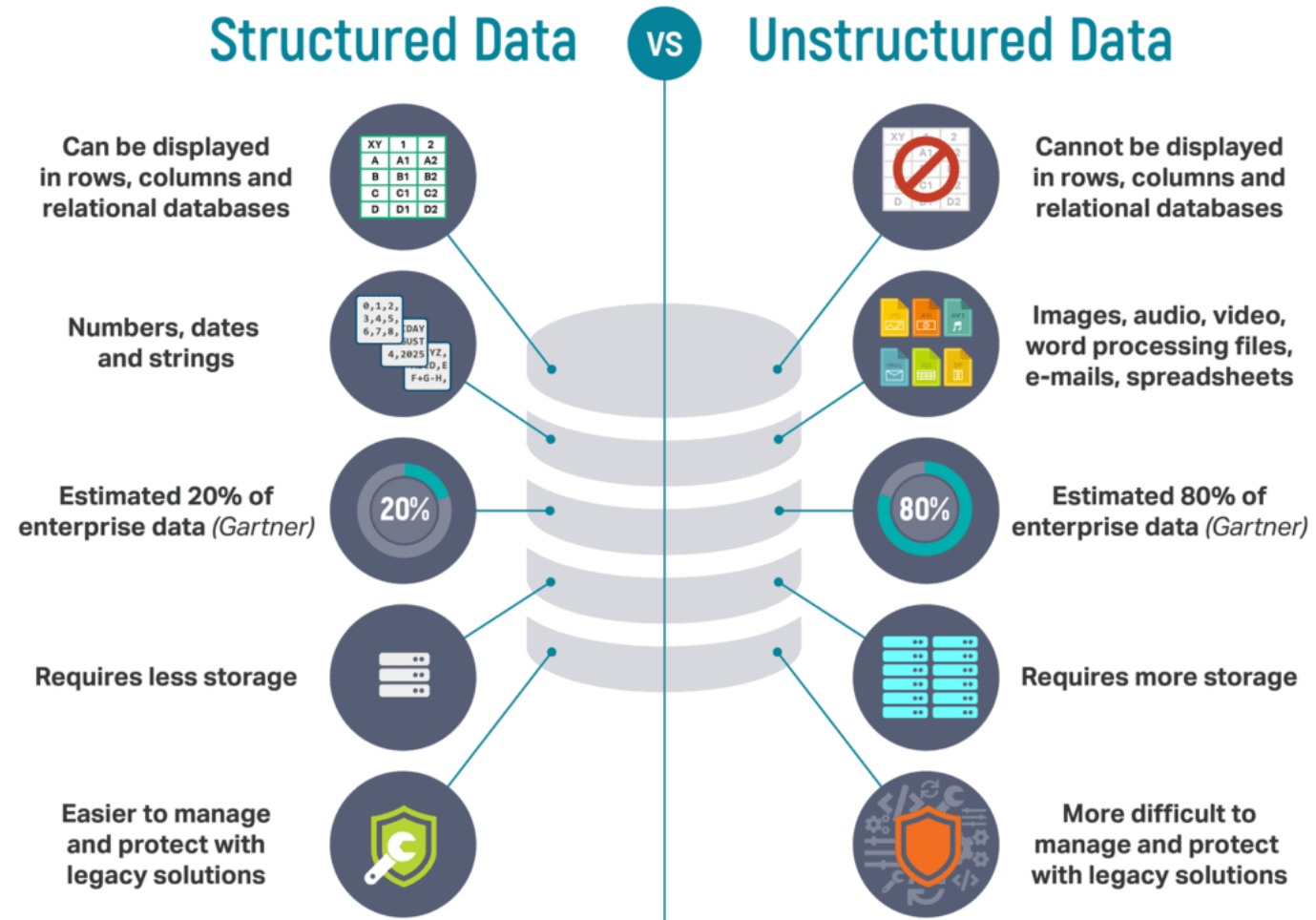
Application specific
Fixed domain
Learns from supplied data sets
Reflexive
Capabilities don't transfer to other areas
TODAY

GENERAL INTELLIGENCE



Can perform almost any action
Self-learning & reasoning
Learns from a few examples and unstructured information
Full range of human cognition
Capabilities transfer to new areas
THE FUTURE?

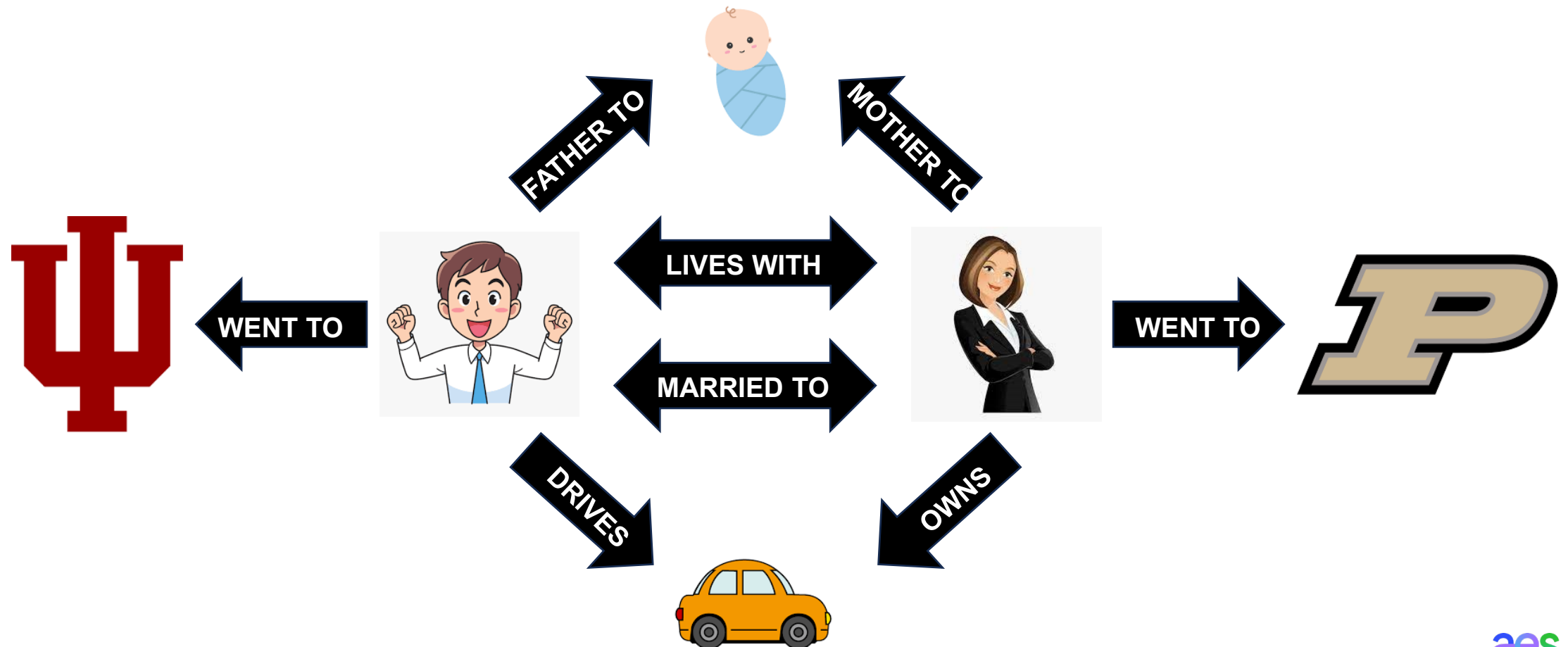
Types of Data



SOURCE: [Structured Data vs. Unstructured Data | Semi Structured Data 2023 \(k21academy.com\)](https://www.k21academy.com/structured-data-vs-unstructured-data-semi-structured-data-2023/)

Seeing Relationships and Value in Data

GRAPH DATABASE – Data is expressed as a series of nodes and relationships to each other.



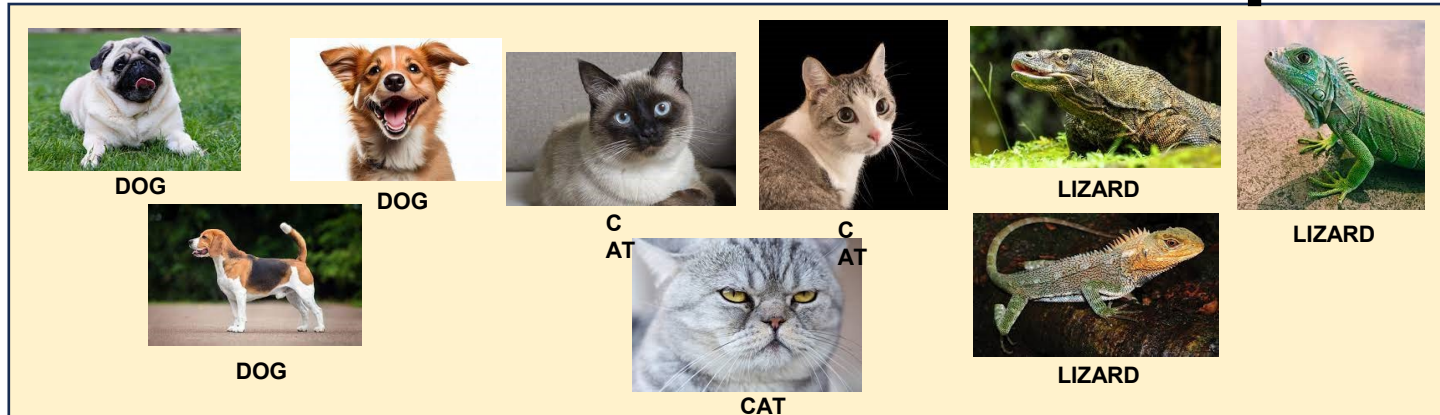
Supervised Learning

SUPERVISED LEARNING – Labeled data sets enable training to make predictive outcomes.

LABELS



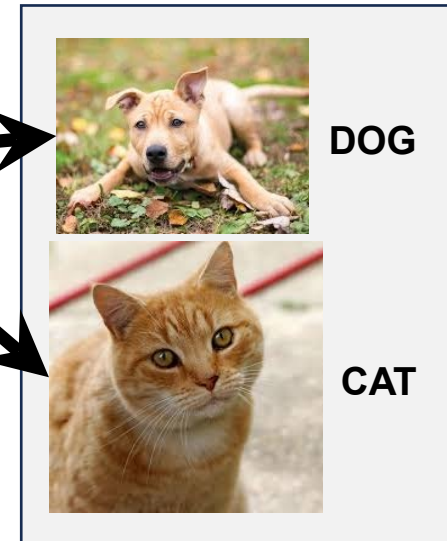
LABELED DATA



**MODEL
TRAINING**



PREDICTION



TRAINING DATA

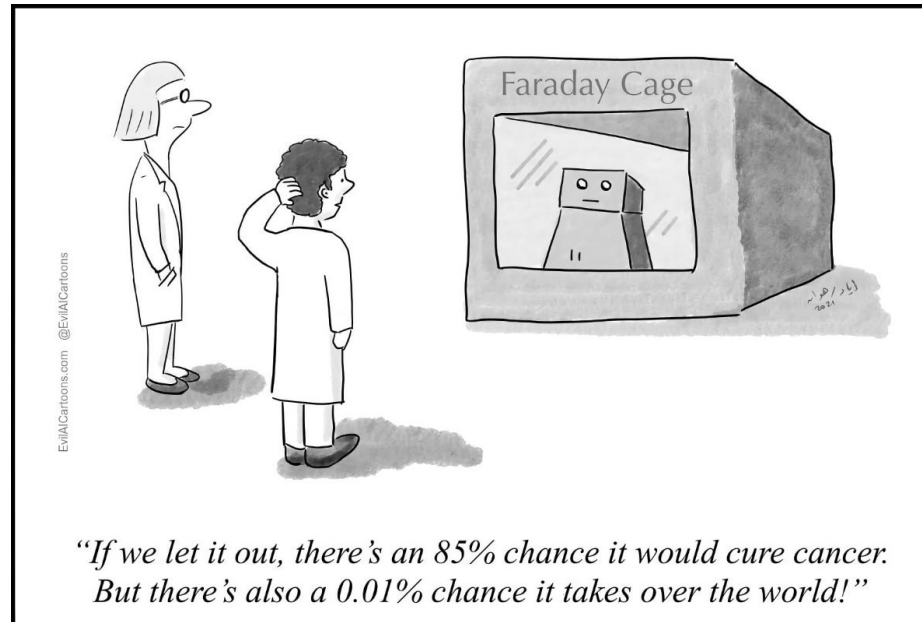


What Is the Model Doing?



<< Bad for whom? >>

EMERGENCE – Model does something unexpected



EXPLAINABILITY – How do we explain or interpret the model's inner workings



HALUCINATIONS – Model results are patently false

How Are Utilities Using AI Today and Tomorrow?

WHERE / WHO

Use of AI isn't limited to operations or "engineering-heavy" functions. In fact, **every business function** can benefit from the use of AI.

WHAT

FORECASTING – Predicting needs and issues before they occur, helping companies be more proactive and safer while reducing future costs.

AUTOMATION – Enhancing the speed and quality of decision-making to make systems more reliable and capable.

COMPUTER VISION – Training models to visually identify assets and issues.

THANK YOU!

Raiford Smith

raiford.smith@aes.com

<https://www.linkedin.com/in/raifordsmith>

NARUC Innovation Webinar Series



Join us next month for...

Exploring Opportunities for Diverse Talent Recruitment:

A Chat with Govern For America

January 11, 2024 | 3:00-4:00pm (ET)

<https://www.naruc.org/cpi-1/innovation-webinars/>

NARUC thanks the U.S. Department of Energy for its support of this series.

Upcoming in-person training

IDSP Resilience Training

January 24 - January 25, 2024

Irvine, CA

Registration open!