



AI SUMMIT TOP TECH

This program is sponsored by the
APWA Technology Committee

AI Summit

Wednesday, January 29, 2025

- 11:00 a.m. - 2:00 p.m. ET
- 10:00 a.m. - 1:00 p.m. CT
- 9:00 a.m. - 12:00 p.m. MT
- 8:00 a.m. - 11:00 a.m. PT

Thursday, January 30, 2025

- 11:00 a.m. - 1:00 p.m. ET
- 10:00 a.m. - 12:00 p.m. CT
- 9:00 a.m. - 11:00 a.m. MT
- 8:00 a.m. - 10:00 a.m. PT

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- To receive CEU's, you must correctly answer 80% of the questions.



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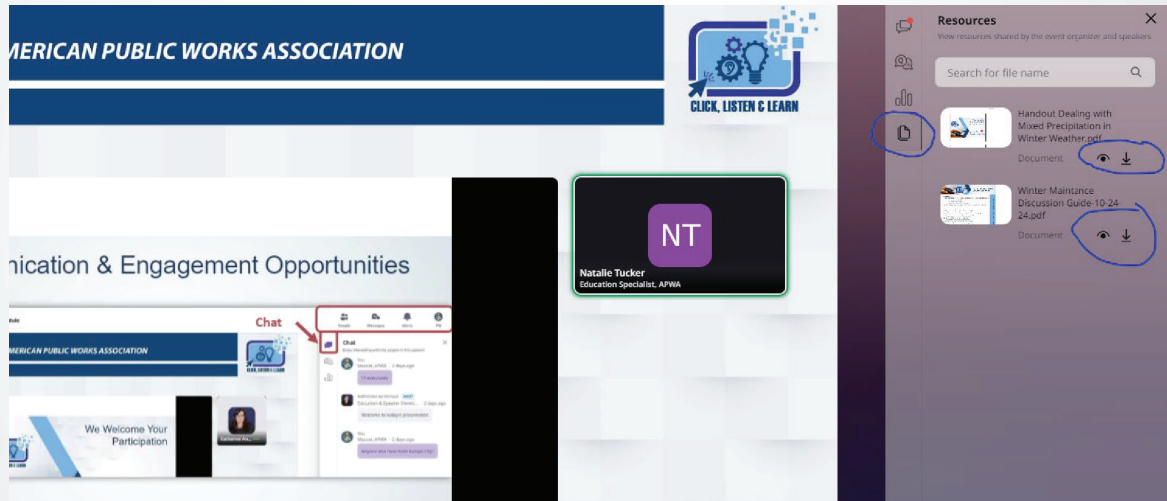
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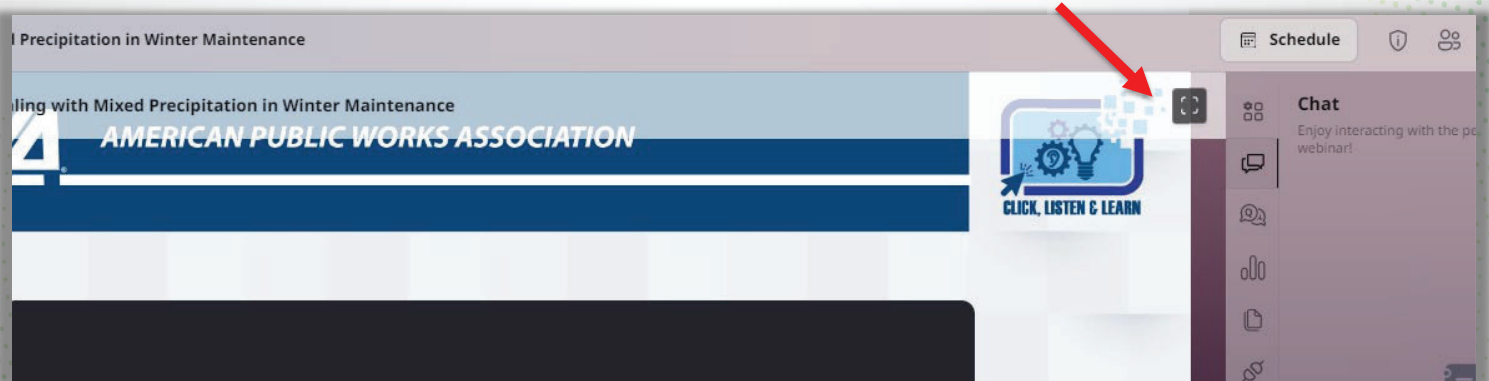
Handout for Today's Program can be download from the right-hand chat panel



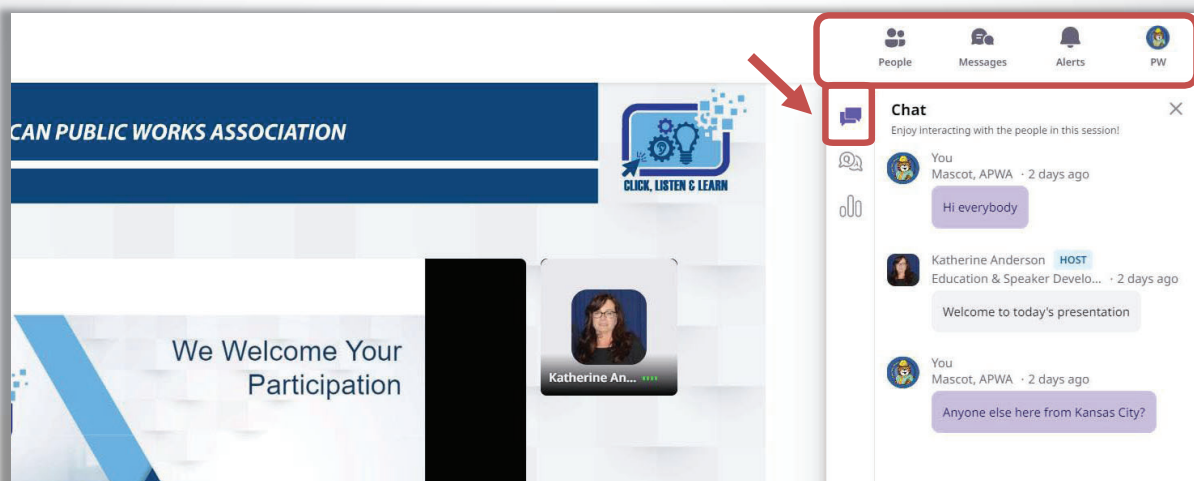
We Welcome
Your
Participation



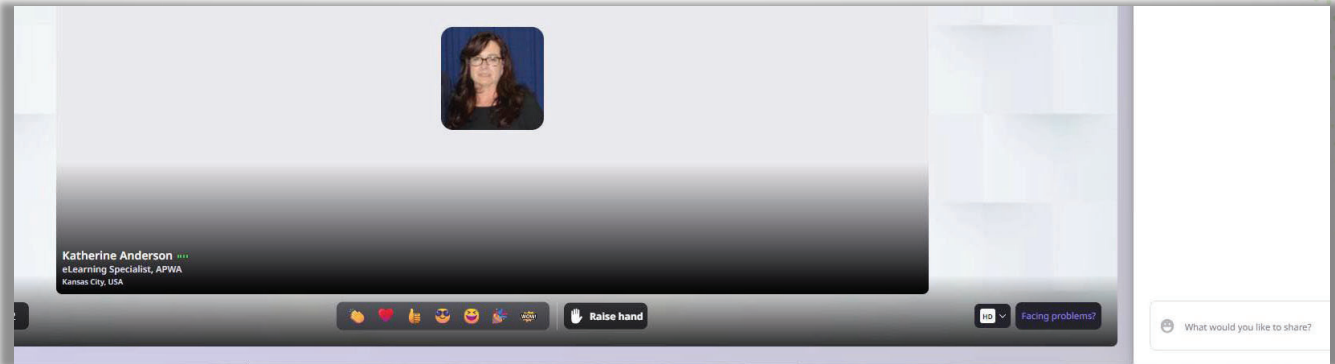
Viewing the Presentation



Communication & Engagement Opportunities



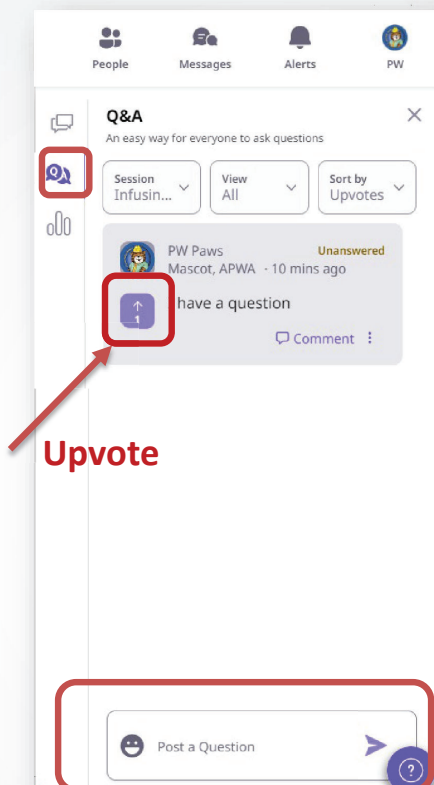
Reactions



Program Questions

1. If you have questions for our speakers, you may ask them using the Q&A feature.

2. Choose to **Upvote** a question that is the same as your question.



Today's Moderator



Tracy Warner, PE
Deputy Director of
Development Services
Pima County



Polls



Session One Speakers:



Mike Millette
Director of Public Works
Village of South Elgin, IL



Adam Carnow
Industry Specialist for Public
Works
ESRI



Defining AI & Its Key Components





Mike Millette, P.E.
Director of Public Works
Village of South Elgin, IL
MMillette@southelgin.com



Adam Carnow
Public Works Industry Specialist
Esri – Charlotte, NC
acarnow@esri.com



Defining AI & Its Key Components

- Define what AI is, which parts of public works it has already impacted, and which are likely to be impacted next.
- Compare the different ways AI might impact public works over the next five years.
- Evaluate the benefits and drawbacks of using AI in public works.



What is AI?

- Machines achieving human-level intelligence

**Artificial
Intelligence**



Source: Esri, Inc.

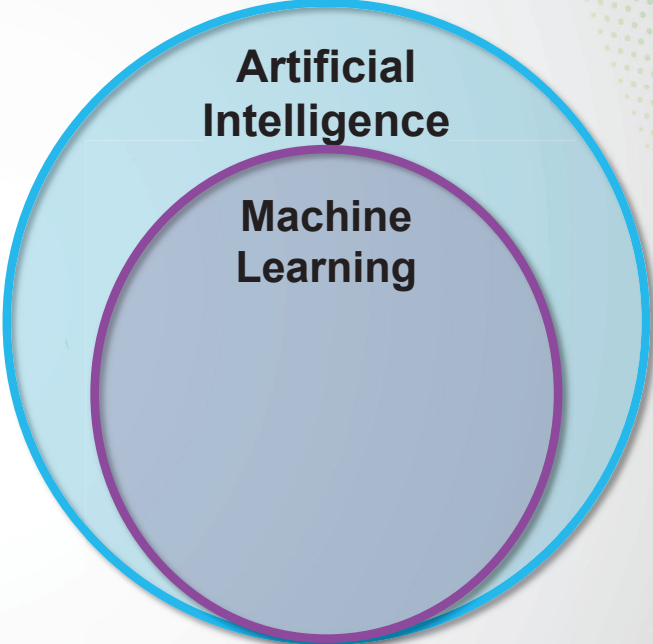


What is AI?

- Machines achieving human-level intelligence
- ML is about extracting patterns from data.

**Artificial
Intelligence**

**Machine
Learning**

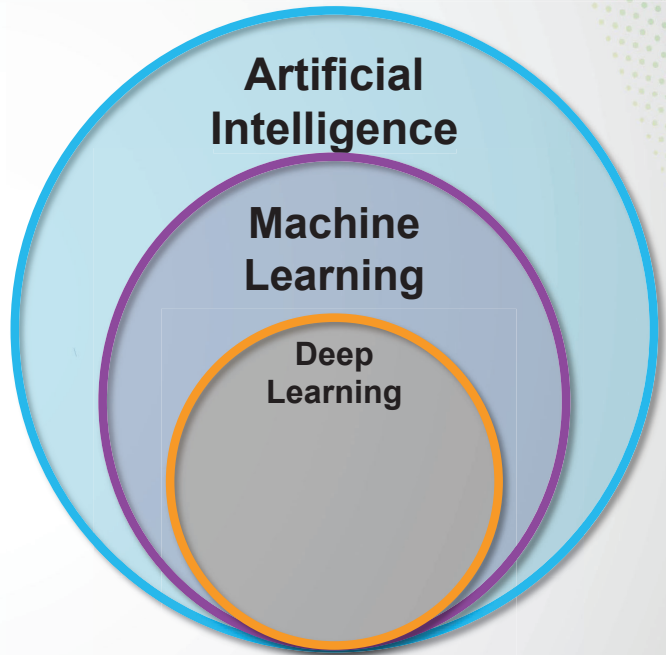


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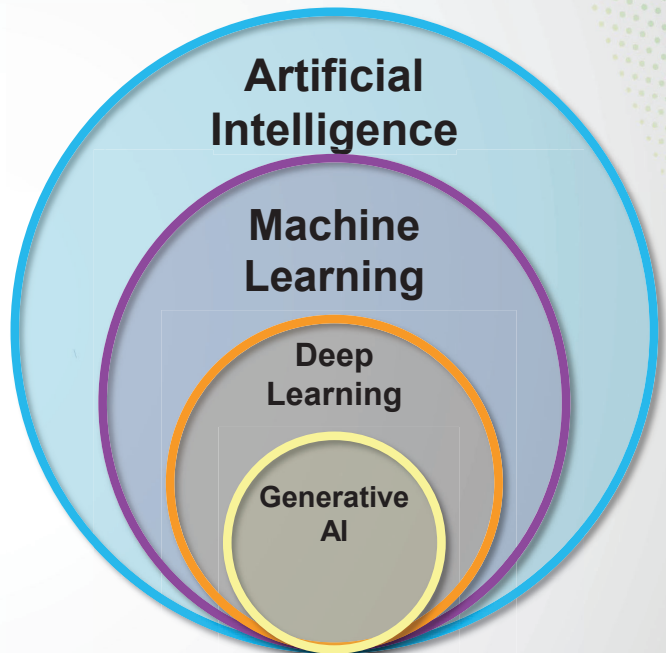


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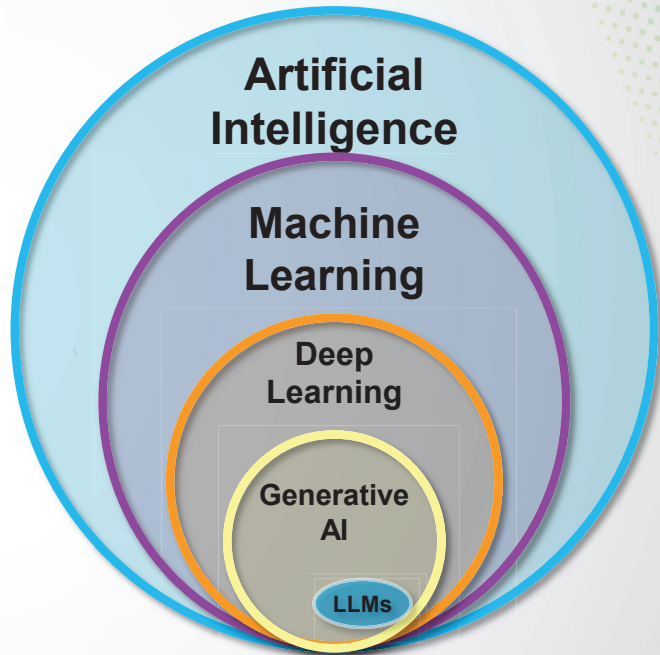


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- Large Language Model (LLM) – Generative AI for text

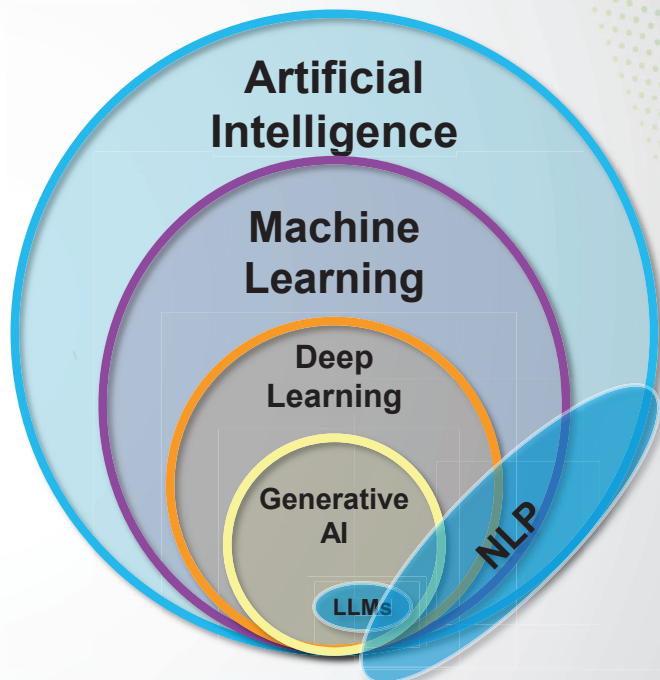


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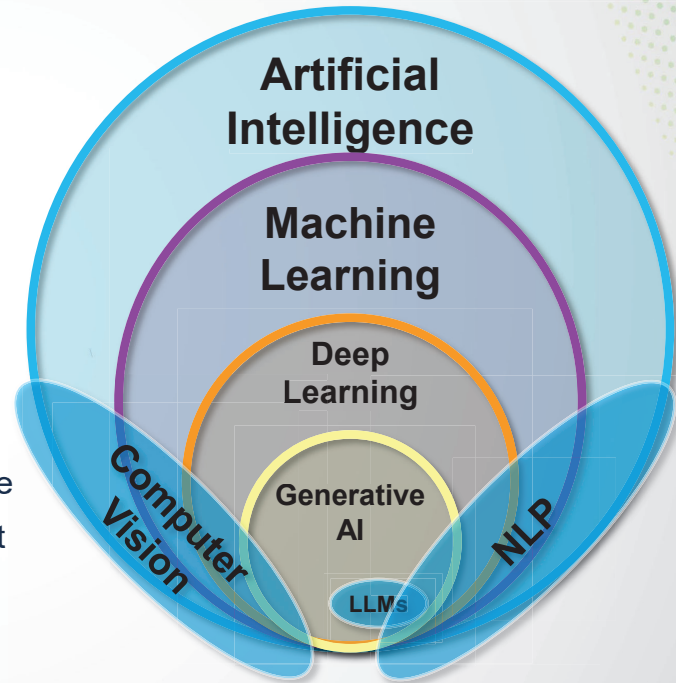


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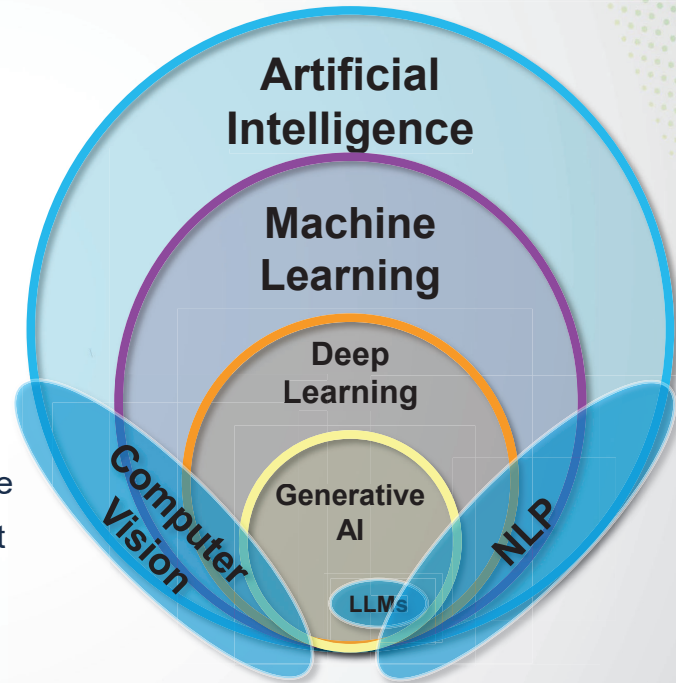
Takeaways

- Generative AI vs. Non-Generative AI
- Generic Opportunities for AI vs. Public Works Specific AI Opportunities
- AI Requires Human Supervision



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How has AI impacted Public Works?

- Generative
- Non-Generative
 - GeoAI = AI + GIS



GeoAI's Impact on Public Works

- Since most Public Works data has a location, AI use has started with GIS
- GeoAI has been in use for over 15 years



How is GeoAI helping?

- Object Detection
- Prediction
- Pattern Detection



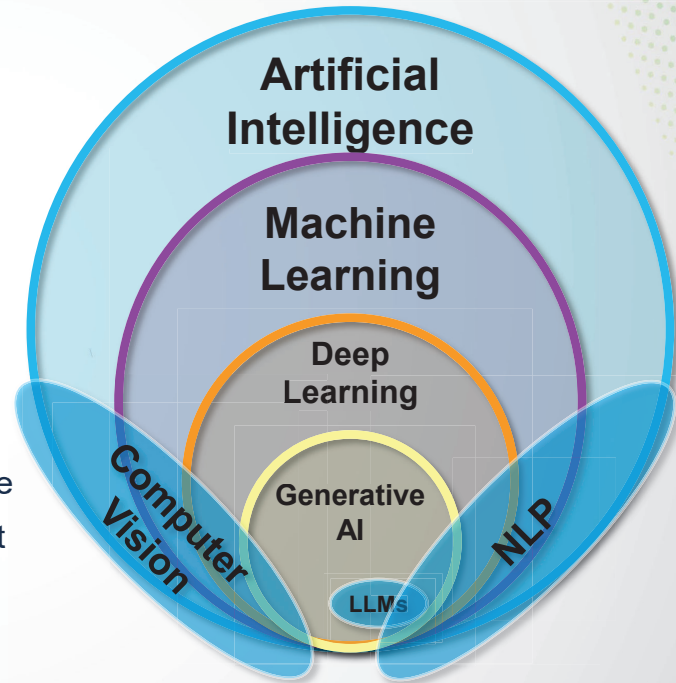
Object Detection Examples

- Cobb Co., GA manages pedestrian traffic
- Tempe, AZ automates graffiti removal
 - Goal 1 every 4 miles, before: 15+, after 1.3
- Charlotte, NC automates water meter mapping
 - Expected annual savings = \$300,000
- Douglas Co., NE automates ADA curb ramp mapping
 - Saved 6 months of staff time, more than doubled inventory
- Salem, OR automates tree loss estimates from ice storm
- Hillsborough Co., FL automates tree mapping
- Raleigh, NC automates traffic data collection
- Escondido, CA automates trail usage data collection
- Seer.ai automated post disaster routable street network in 24 hours



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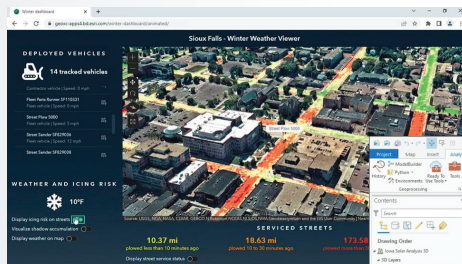
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Prediction Examples

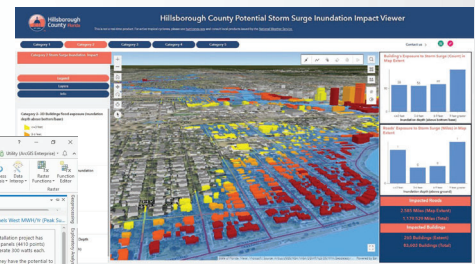
- Sioux Falls, SD predicts icing risk
- Hillsborough Co., FL predicts storm surge flooding
- GA DOT predicts the ROI from solar panel installation in RoW



Sioux Falls, SD – 3D GeoAI Icing Risk Model



Georgia DOT Right-of-Way Solar Energy Potential

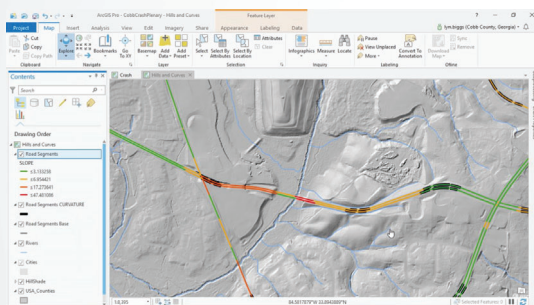


Hillsborough Co., FL Storm Surge Model



Pattern Detection Examples

- Cobb Co., GA single vehicle fixed object crash analysis
- Brevard Co., FL traffic crash analysis



Cobb Co., GA Traffic Crash Analysis



Brevard Co., FL Traffic Crash Analysis



What's next for Public Works and AI?

- AI moving to the edge
- Data collection & analysis improvements
- Better predictions (asset management, disasters, etc.)
- Generative AI
 - Automated design of field surveys
 - Automated map creation & spatial analysis
 - Automated real-time image recognition (attributes, annotation, redaction)

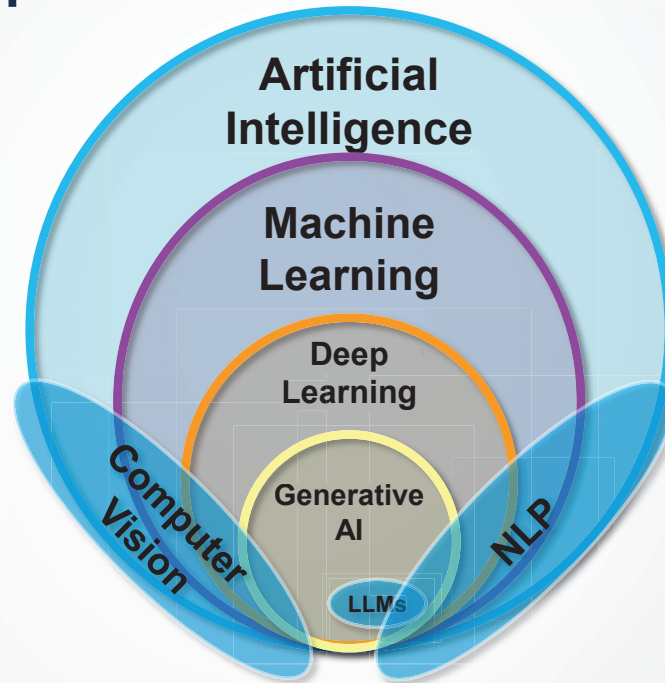


Public Works & AI – Benefits & Drawbacks

- Benefits
 - Automation = Time Savings, Better Data Quality
 - Prediction = Proactive Preparation, Reduced Project Risk
 - Analysis = New Insight
 - Better Decisions
- Drawbacks
 - Generative AI requires managing risk, bias
 - Requires human supervision
 - Requires large amounts of quality data, new skills, resources



Questions?



Source: Esri, Inc.



Session Two Speakers:



Chris Lareau
Co-Founder, COO
Vue Robotics



Steve Cacioppo
Senior GIS Analyst
Douglas County GIS



How AI Systems are Developed and Trained

Day 1, Session 2



AI SUMMIT
TOP TECH

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Learning Objectives

- Describe the engines within AI systems.
- Explain what large language models (LLM) are and how transformer models are part of LLMs.
- Identify the role of data in training AI systems- how much is needed, what quality control must be done, and so forth.



Image Source: Vue Robotics



AI Engines



What is an AI Engine?

An AI engine is a subset of machine learning that processes and analyzes vast amounts of data, recognizes patterns and makes decisions or predictions. It allows the system to learn and adapt to varying conditions and data sets and provide an output.

An AI engine is like a vehicle in a fleet or a specialized tool. Each vehicle shares some similarities but serves a specialized purpose. They can work independently to solve a specific task, or multiple vehicles can work together to solve more complicated problems.



Image Source: Adobe Stock (licensed by Vue Robotics)



Types AI Engines

Natural Language Processing (NLP)

Understand and process human language, both text and speech.

Example: ChatGPT and customer service chatbots.

Generative AI

Create new content, such as text, images, and search results.

Example: AI writing tools generating stories or articles.

Computer Vision Engines

Analyze and interpret visual data like images or videos.

Example: Detecting objects in self-driving car camera feeds.

Deep Learning

Multiple layers of neural network "nodes" are powerful for tasks involving complex, high-dimensional, or unorganized data.

Example: Processing and translating text from images in real-time.

Speech Recognition and Generation

Convert speech to text and text back to speech.

Example: Voice assistants like Alexa or Siri understanding voice commands. destination.

Machine Learning (ML)

Learn patterns from data to make predictions or decisions.

Example: Recommending movies on a streaming platform based on viewing history.

Autonomous Systems

Enable systems to operate independently in real-time environments.

Example: Drones navigating obstacles to deliver packages.

Decision-Making and Optimization "Experts"

Find the best solution among many possibilities.

Example: Waze or Google Maps determining the fastest route to a

Big Data and Analytics

Process and analyze large-scale datasets to extract insights.

Example: Amazon identifying buying trends from user activity.

Edge AI

Perform AI tasks on devices with limited resources, without relying on the cloud.

Example: Apple Watch analyzing heart rate and step count in real-time.



AI Engine Architecture Diagram

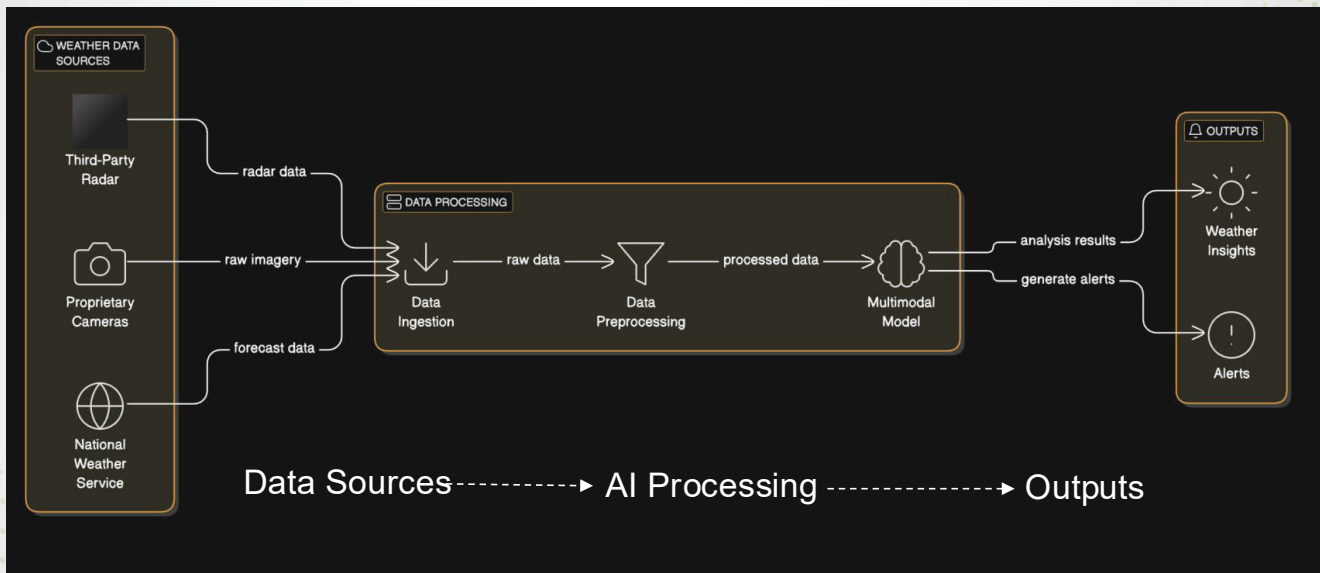
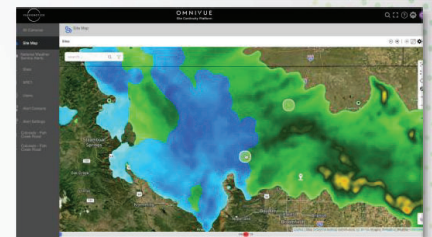
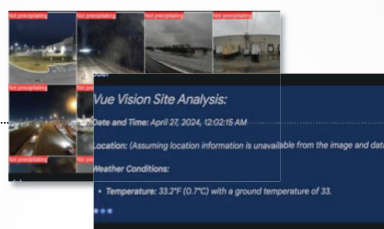


Image Source: Vue Robotics, eraser.io

AI Engine Example



Task-Specific

A computer vision engine for weather prediction focuses on analyzing visual data, such as satellite images, radar scans, or camera feeds, to identify patterns and forecast weather.

Example: Analyzing local camera feeds to determine road weather conditions.

Powered by Models

AI engines use one or more models to process data and produce outputs.

Example: A model detects snow or flooding being present on the serviceable area of a road and classifies the conditions.

Integrated into Larger Systems

Computer vision engine works alongside other weather forecasting engines and engines that live on device (physical hardware) to provide a comprehensive condition analysis and forecast.

Example: The engine identifies flooding patterns which are combined with tidal, rainfall and flood plain data for detailed, predictive forecasting

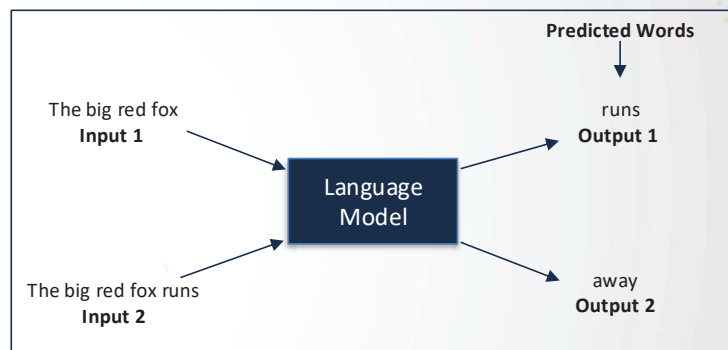
Images Source: Vue Robotics

Large Language Models LLMs



Large Language Models (LLMs)

- A **large language model (LLM)** is a type of artificial intelligence (AI) designed to process and generate human-like text. The "large" in LLM refers to the billions of parameters in the model and the data it has been trained on, which enables it to learn and represent complex language patterns, structures, and contexts.
- Early LLMs were used to simply predict the next word based on the text before it.
- **Transformers** are the underlying architecture of what makes LLM today special. Helps these models more effectively understand the order of words in a sentence, which is crucial for understanding the context and meaning of a sentence.



In LLMs, text is converted into numbers, which enables generative and natural language processing models to process them.

The Role of Data in Training



Role of Data in Training

- Proprietary data is your greatest differentiator.
- Good data = good models = meaningful outputs.
- Depending on the type of data, sourcing, scrubbing, segmenting, and labeling can still be very manual processes when developing a new mode or tuning an existing one.

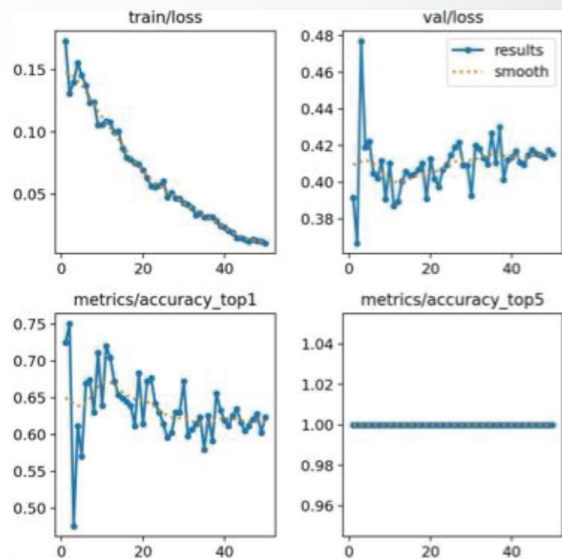


Image Source: Vue Robotics



Detecting Precipitation Example

Data Set Overview

- 1747 Images Labeled
- 45 Unsure (Removed - Bad Data)
- 113 Precipitation (~6.4%)
- 669 Maybe (~38.2%)

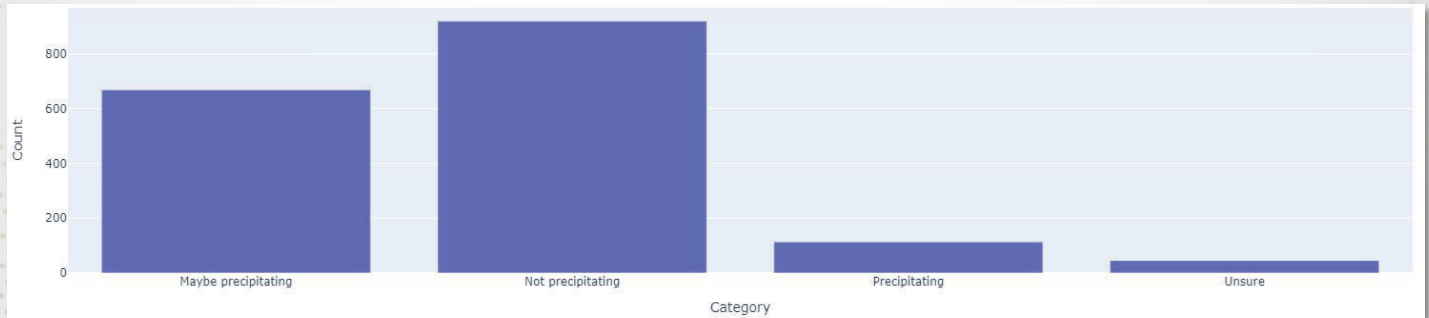
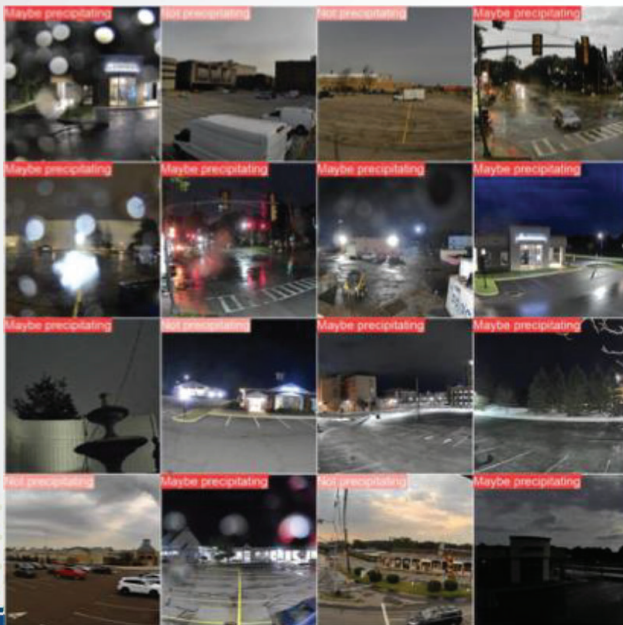


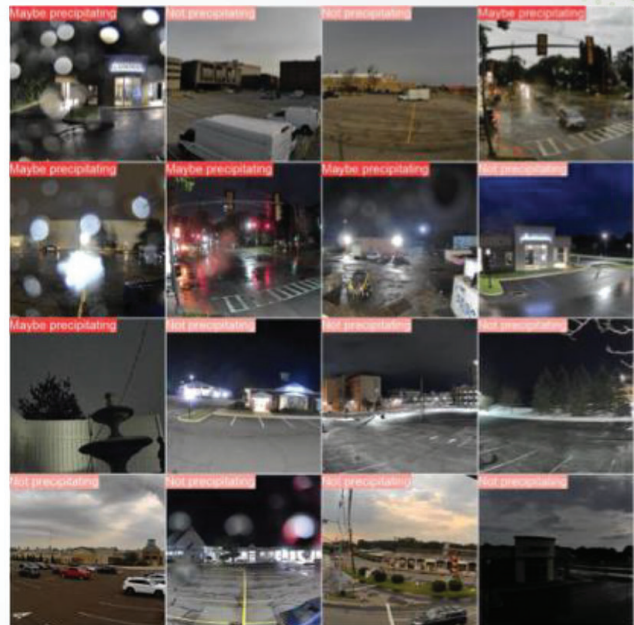
Image Source: Vue Robotics



Ground Truth (L)



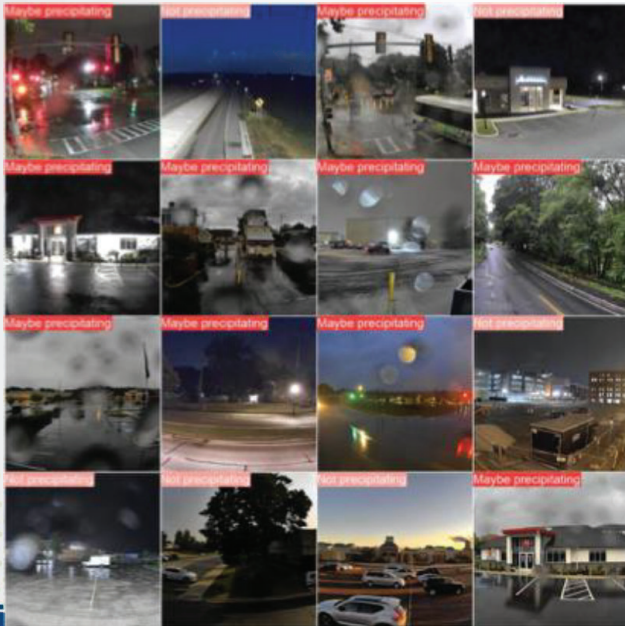
Prediction (R)



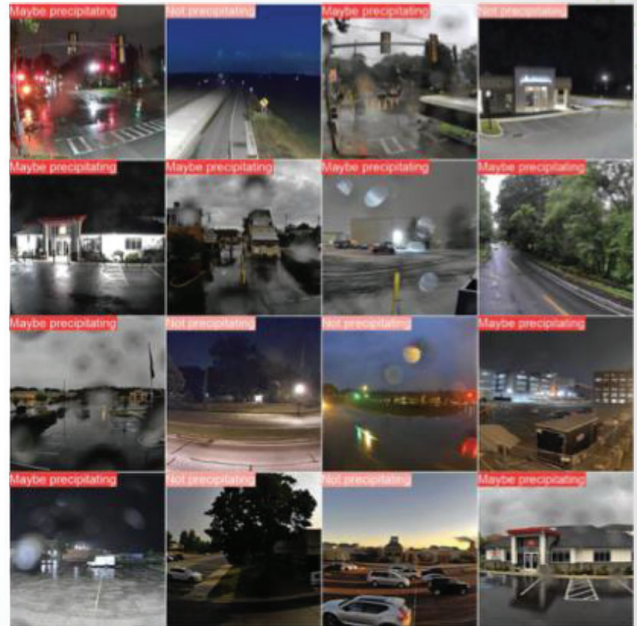
Images Source: Vue Robotics



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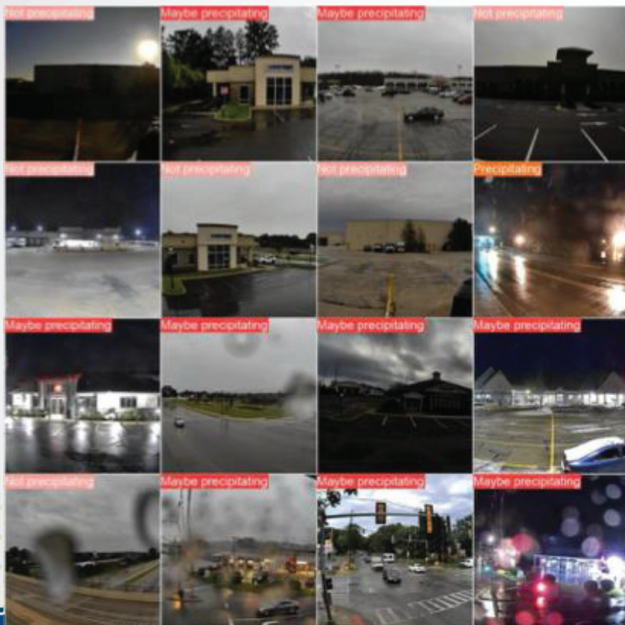


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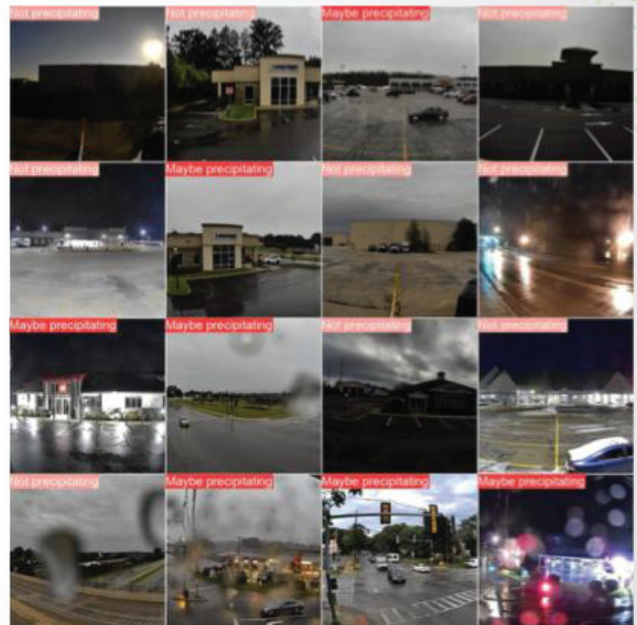


Images Source: Vue Robotics

Ground Truth (L)



Prediction (R)



Images Source: Vue Robotics

End Result



Images Source: Vue Robotics



ADA Curb Ramp feature extraction using ESRI's Deep Learning tools

Steve Cacioppo - Douglas County, NE GIS

scacioppo@douglascounty-ne.gov



City of Omaha Construction Division needed assistance identifying all of their ADA Curb ramps

- They had an incomplete and inaccurate inventory of ADA curb ramps
- This might be a good opportunity to try using ESRI's Deep Learning tools
- ADA curb ramps are easy for a human to pick out from an aerial photo, should be easy for the computer too



Where to begin?

- Not a ton of resources when I began my journey
- ESRI Blogs to the rescue!
 - Sangeet Matthew from ESRI wrote a detailed blog about how he used ESRI Deep Learning tools to identify Caribou from aerial photography in Alaska. I was able to use his methodology to create my own Deep Learning model to extract ADA curb ramps



Performing Feature Extraction & Classification Using Deep Learning with ArcGIS Pro

Imagery & Remote Sensing
August 02, 2021



Basic steps I used for creating my Deep Learning model

- Read Sangeet's blog and follow his instructions
- Create a LOT of training samples. ESRI recommends 300-500 samples but more is better
- The more training samples you have, the better, more accurate your results will be. I created a total of 753 training samples for my model
- Run your model on a small data set first
- Once you get a model that yields decent results, think about where you should run it



How to run my new Deep Learning model

- My model was trained on our commercial 1" resolution imagery.
- The area of Douglas County, NE is 339 square miles - that a lot of processing!
- Limit the processing to where you would find ADA curb ramps
 - Buffer street centerlines
 - Commercial parcels - have sidewalks & parking lots
 - Parcels that contain apartments & condos
- To speed up processing I also broke up the county into a grid and used an iterator to process the individual squares. Afterwards I appended them into one layer



Results

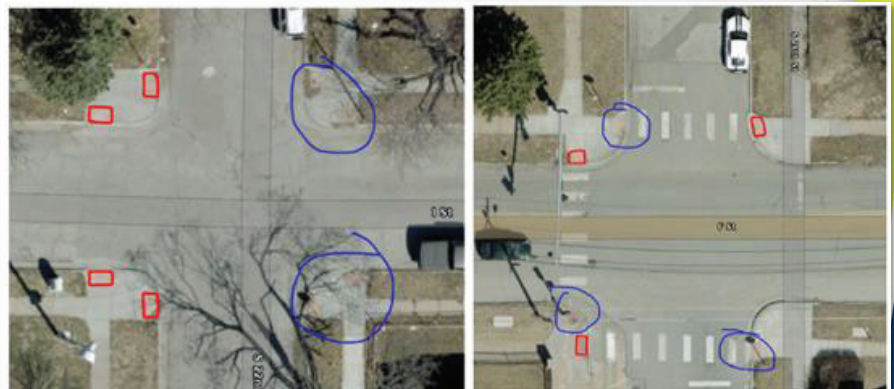
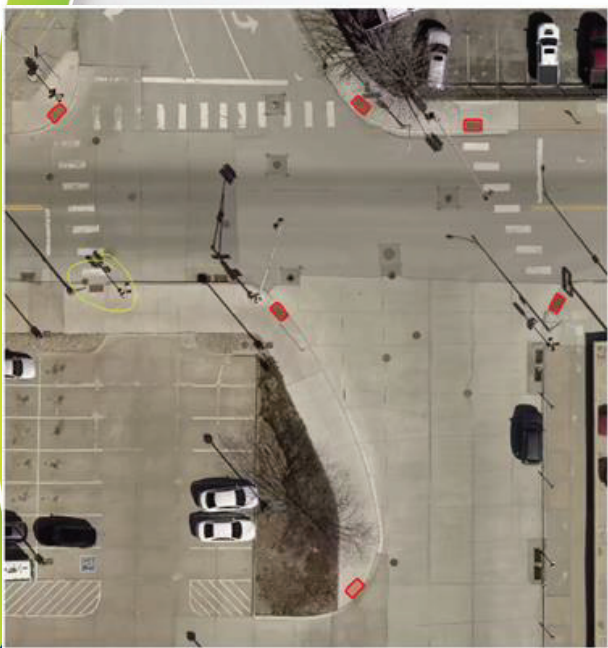
The results from my model were better than I expected. Whereas I did have some missed ramps and some that were errant, the overall results were good

Some of the errant examples are:

- Inlet grates/manhole covers
- HVAC on commercial roofs
- Sun roofs on autos



Results - continued



Lessons Learned

- There were lots of 'technical' bumps along the way - lots of trial and error with the inputs - stick with it!
- 1" imagery is overkill for ADA curb ramps
 - Next time use 3" Mr. SID imagery
- Use of image server or cloud processing
- There is no 'one size fits all' for these Deep Learning models



AI discussions with management

- ChatGPT has given AI a negative connotation with some
- Remember that AI (Deep Learning) is a collaboration between the computer and the human
- The only time there wasn't human interaction with my process is when the computer was actually running my model
- Computers/AI/Deep Learning are only as good as the data you give them



Next Steps

Now that I've successfully created my first model, here's what I want to try and do next:

- Swimming pools
- Pavement crack detection
- Car detection/object tracking
- Trees/species?



In Closing...

ESRI now has 94 pre-trained deep learning models available for download from the ArcGIS Living Atlas. That's up from the 8 pre-trained models they had when I started this journey 2 years ago!

Before you create your own model, download one of these pre-trained models and try it yourself.

If you have any questions, feel free to contact me!



Discussion & Questions

Chris Lareau - chris@vuerobotics.io

Steve Cacioppo - scacioppo@douglascounty-ne.gov



Session Three Speakers:



Eryn Stone, PE
Urban Engineer
Iowa DOT-Local Systems



Joseph Dib, PE, PMP
Senior Civil Engineer
Applied Research Associates



Ömer Bozok, PE
Founder
Phoenix iO



Addressing the Ethical and Legal Considerations of AI

Day 1 – Session 3



**AI SUMMIT
TOP TECH**

Speakers:

Eryn Stone, P.E. – Iowa DOT

Ömer Bozok, P.E. – Phoenix iO

Joseph Dib, P.E. – Applied Research Associates, Inc

Learning Objectives



Identify key ethical issues



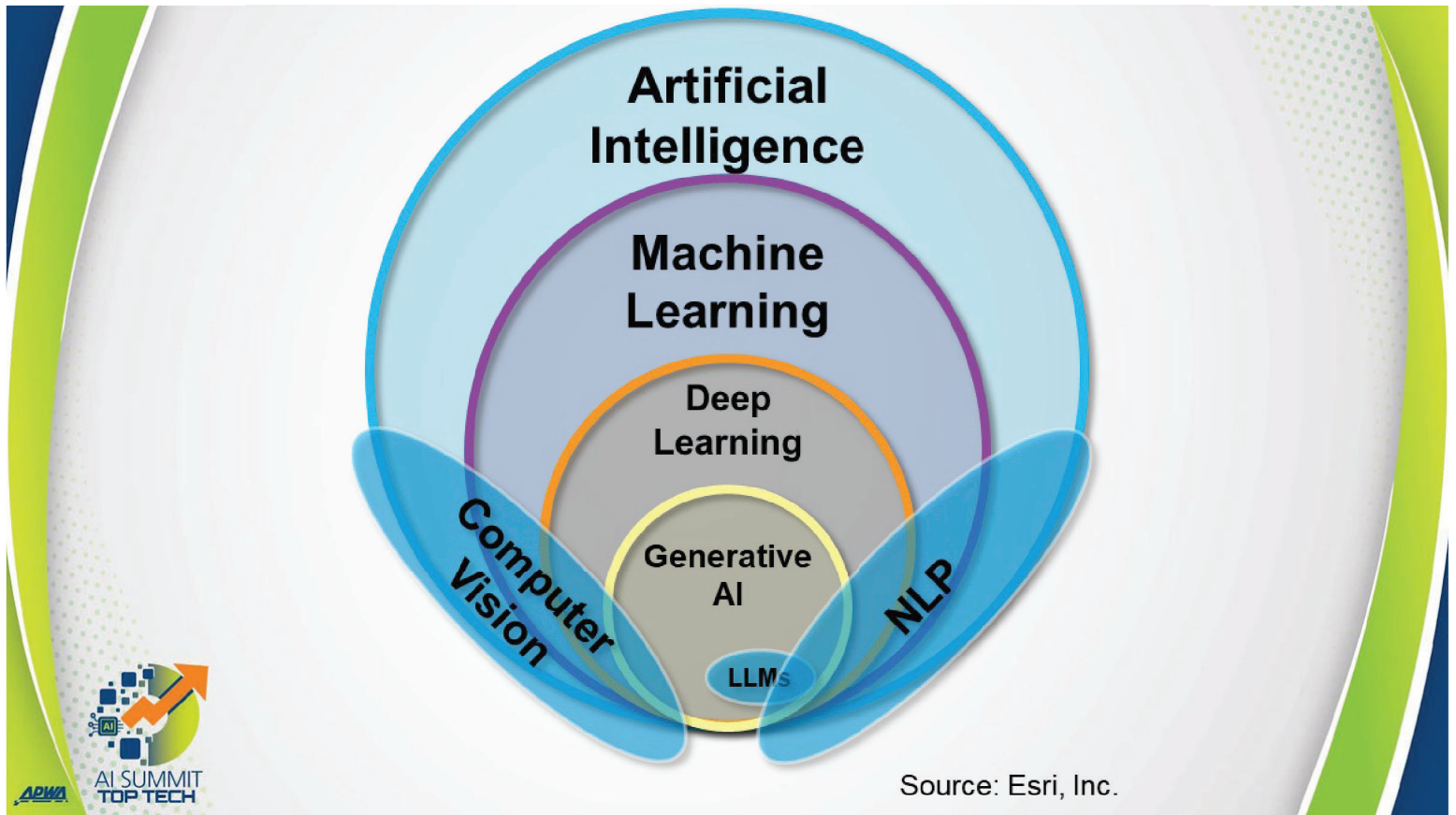
Understand the current legal landscape



Explore strategies to prevent unethical AI uses



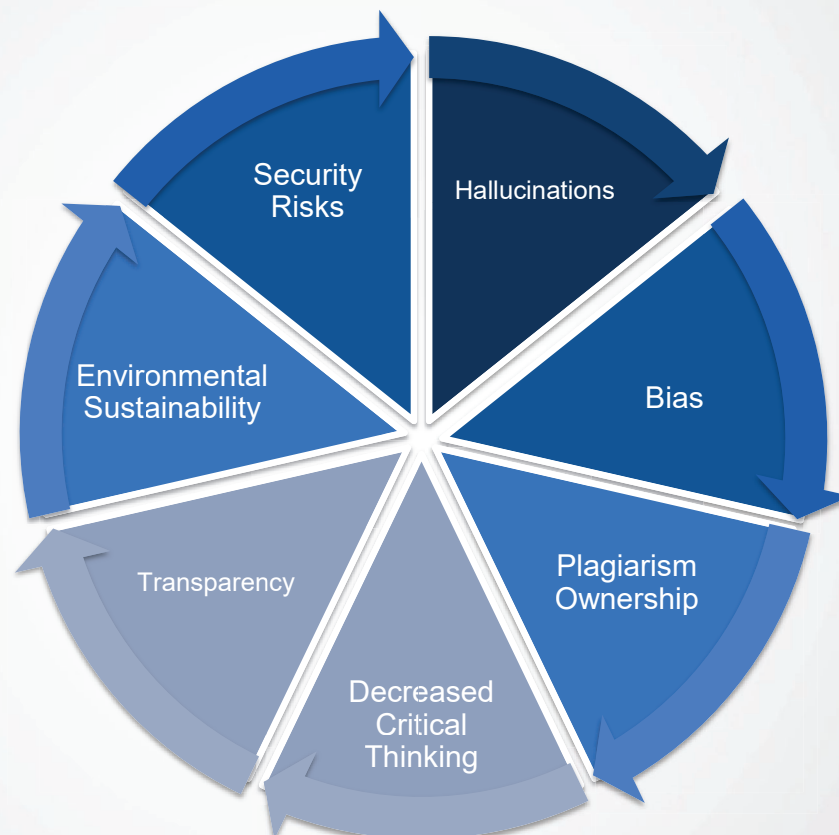
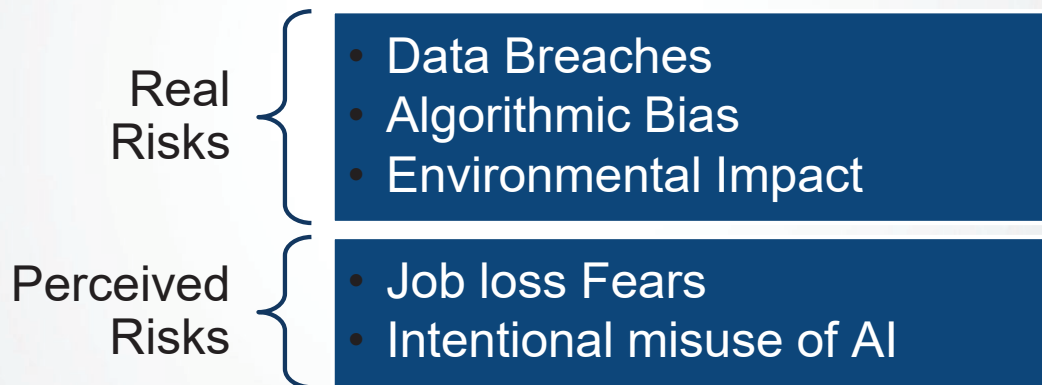
Discuss the educational needs

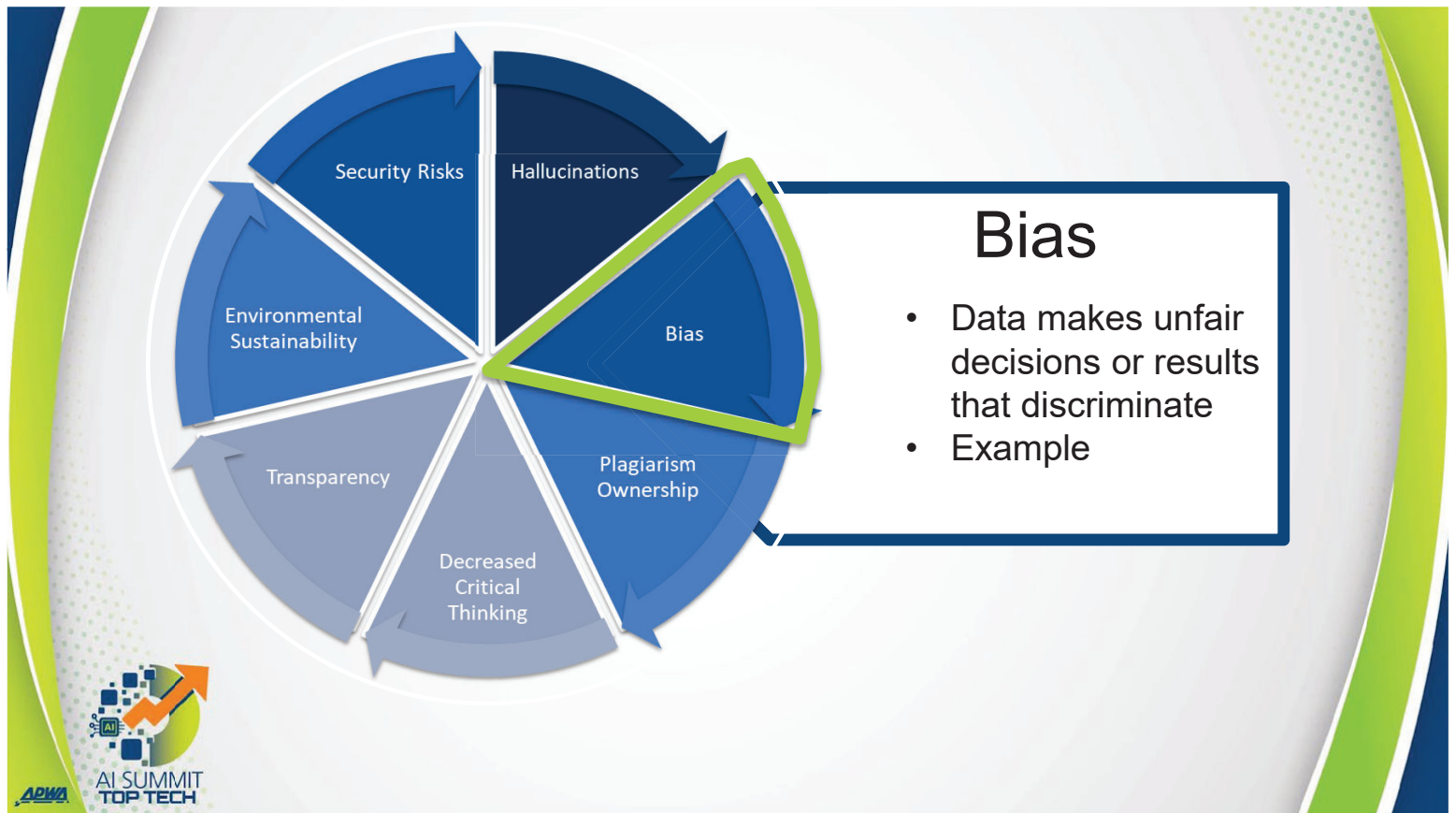
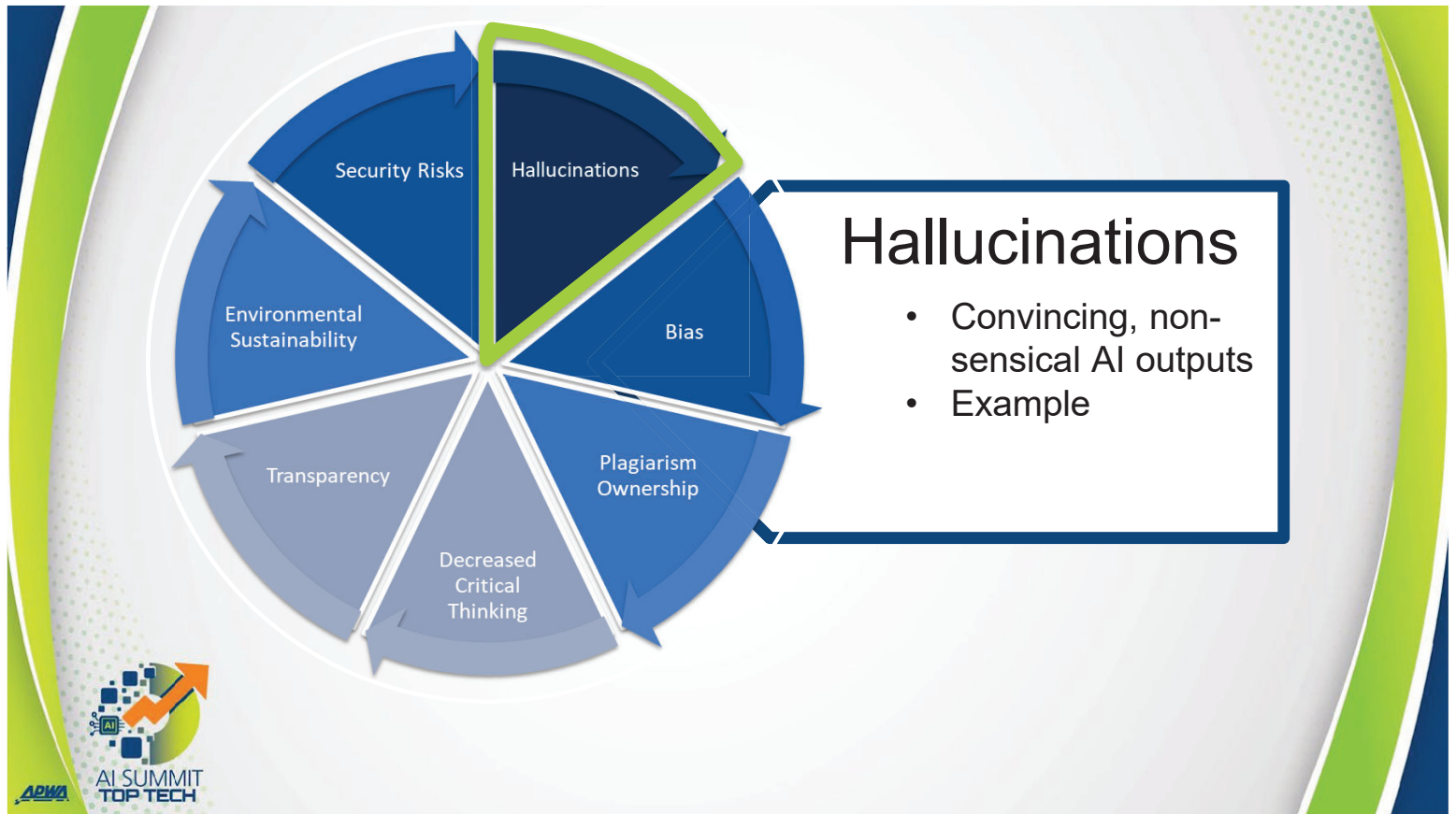


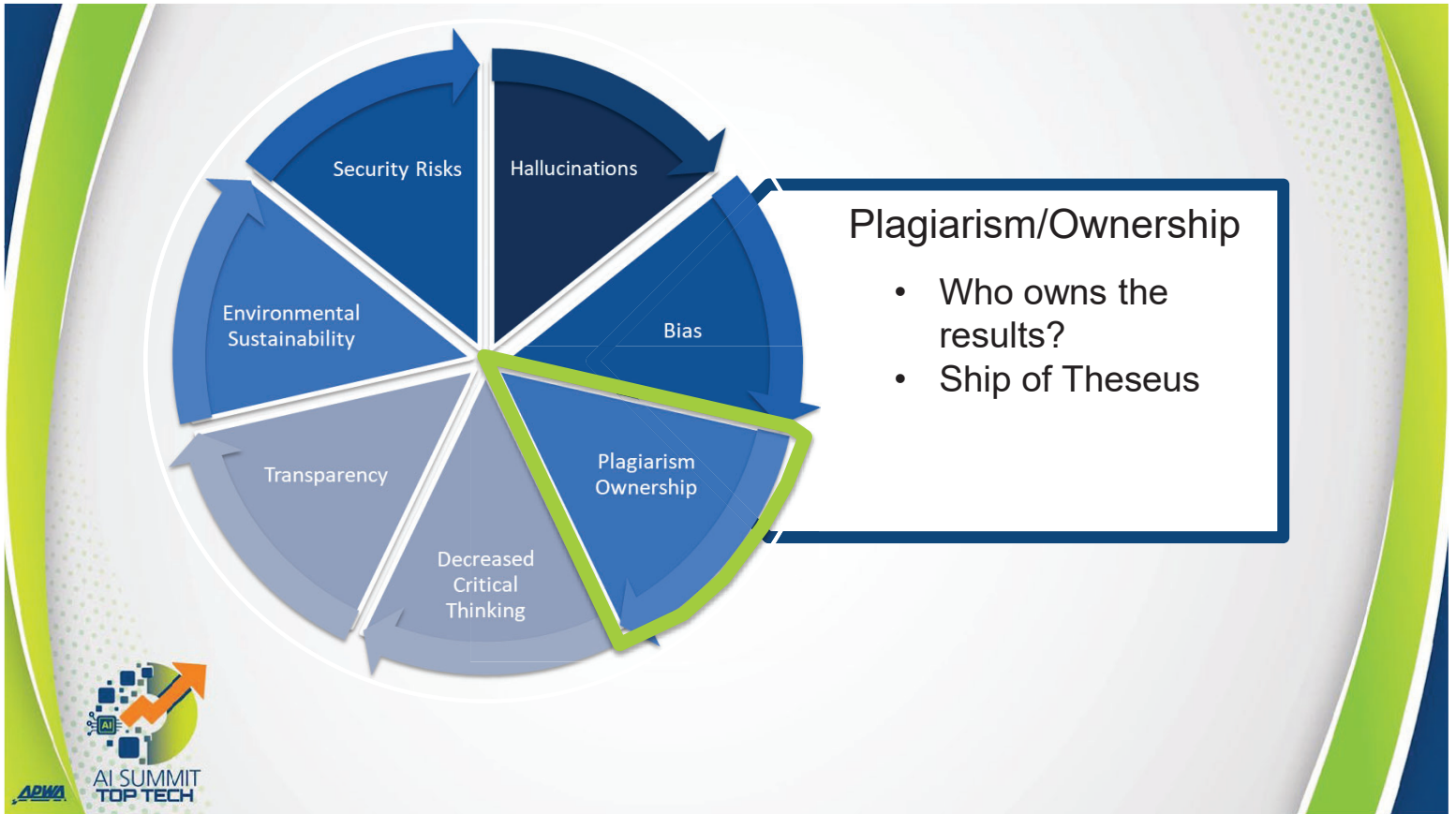
What is Ethics in Public Works?

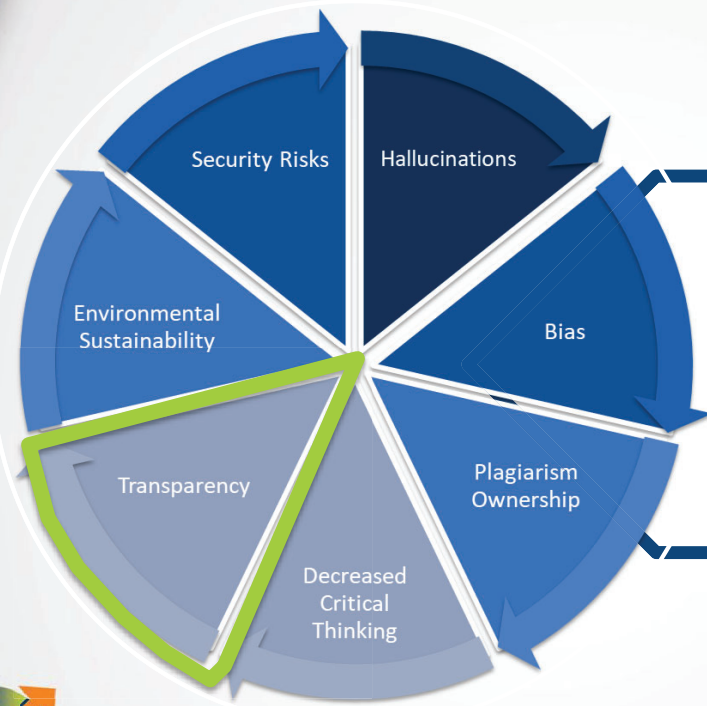


Key Ethical Concerns for AI in Public Works



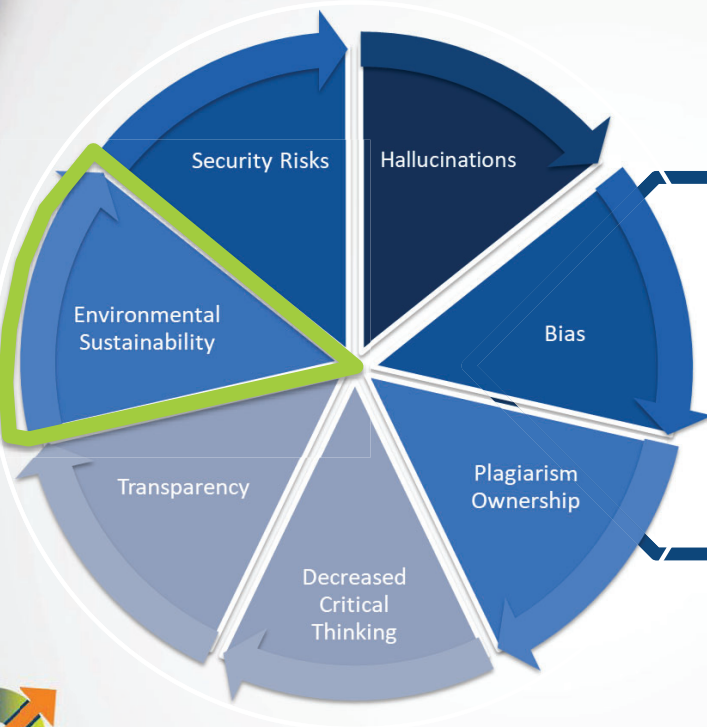






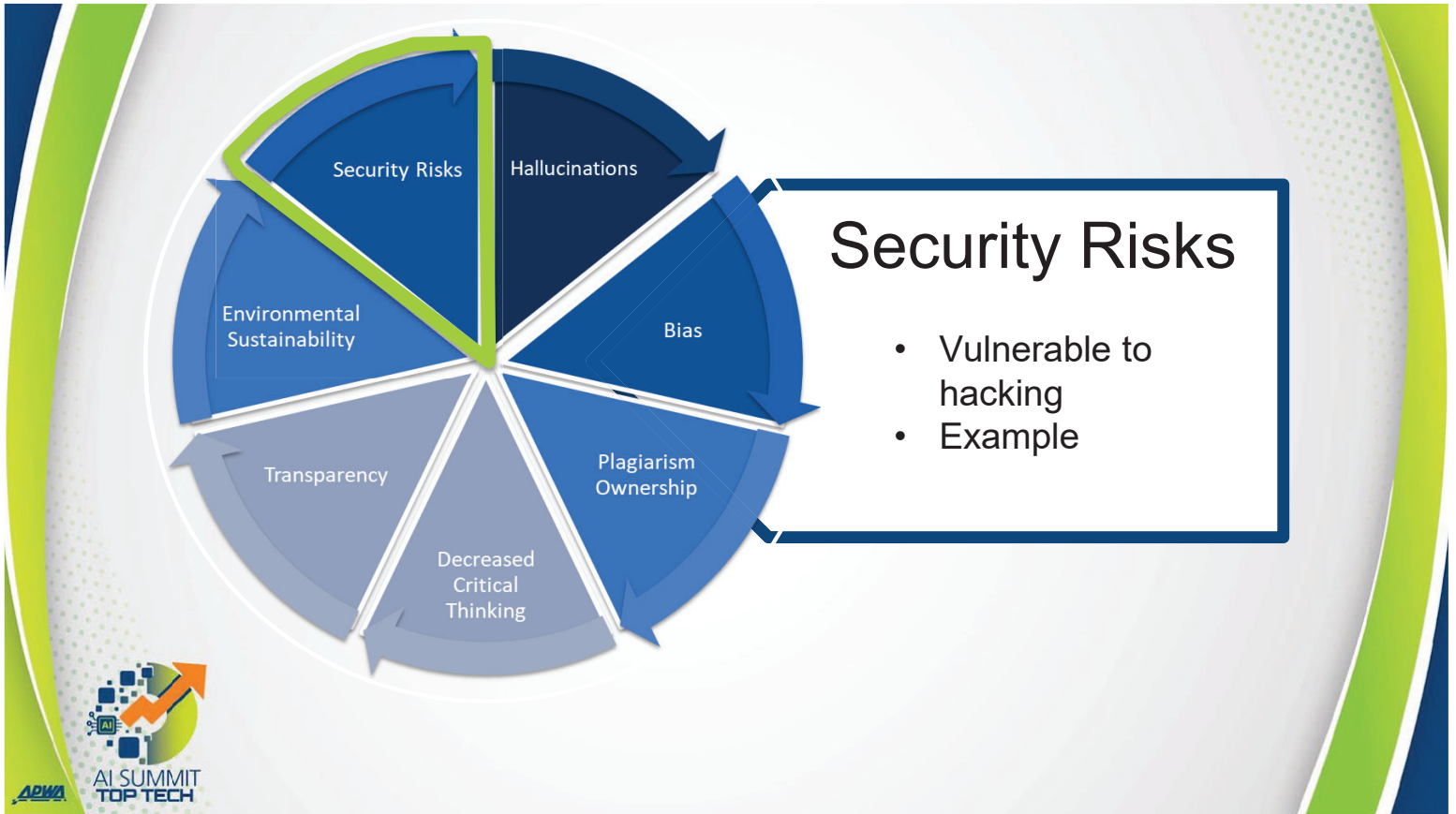
Transparency

- Accountability of how tools function
- Example



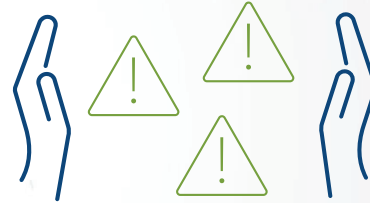
Environmental Sustainability

- Takes many resources to power
- Example





Legal Landscape



Addressing Unethical Use

AI Legal Landscape



AI Legal Landscape - USA

- No enacted federal regulations
 - AI Bill of Rights (Oct., 2022)
- 40+ State have AI bill
 - Colorado AI Act (May, 2024)



AI Legal Landscape - Canada

- No enacted federal regulations
 - Artificial Intelligence and Data Act (AIDA), Jun. 2022
- The Enhancing Digital Security and Trust Act, Nov. 2024 (EDSTA) – Ontario

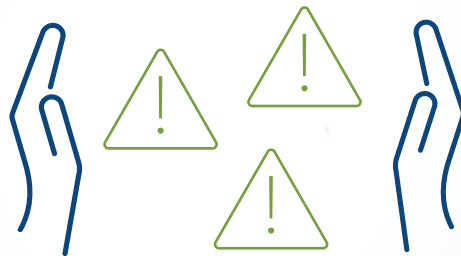


Goal of Regulations

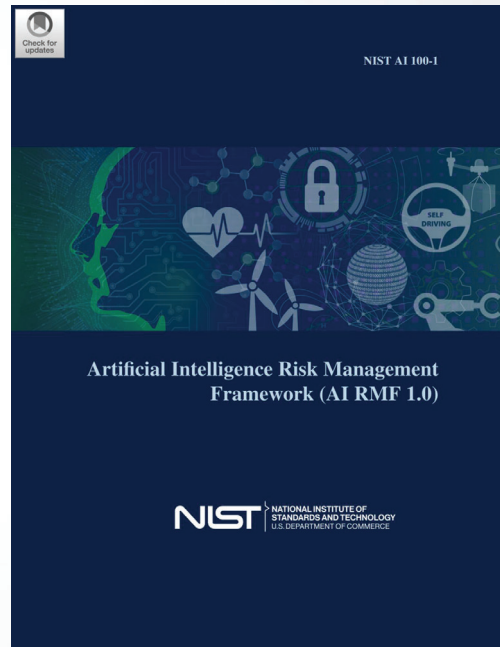
1. Safety and security of the people
2. Responsible innovation
3. Protection of privacy and civil liberties



Addressing Unethical Use



Policy & Governance



Policy & Governance



Ethical AI



Responsible



Equitable



Fair: *Just, unbiased, satisfactory, suitable, appropriate, acceptable, good enough, reasonable*



Ethical AI



Responsible



Equitable



Traceable



Reliable

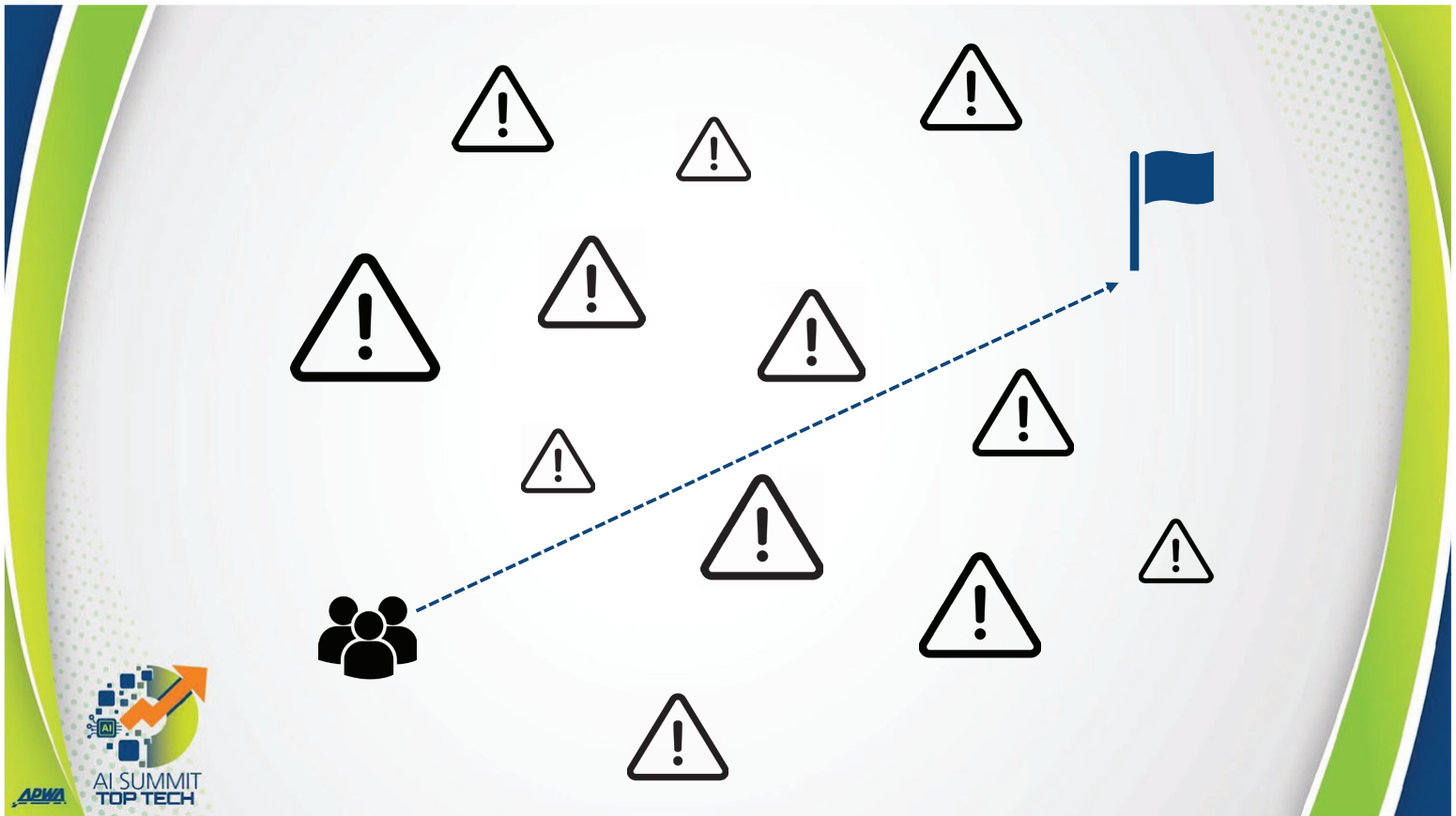
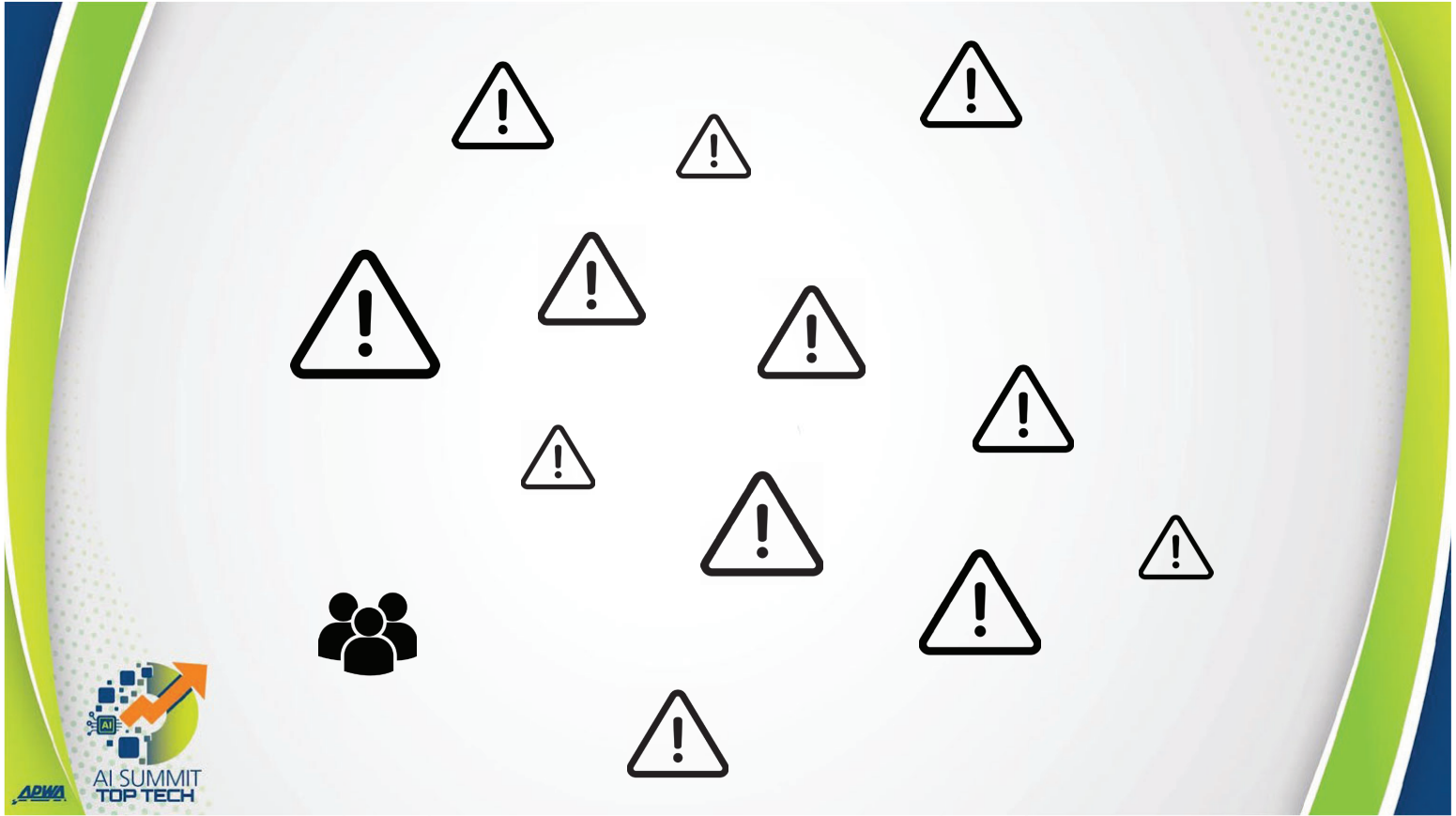


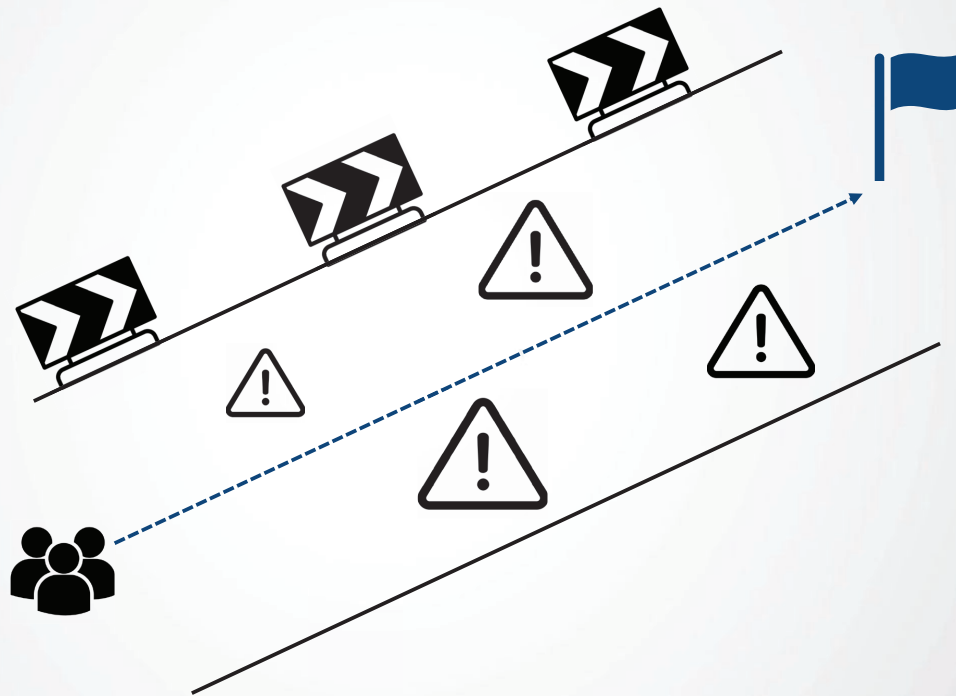
Governable



Aligns w/
Values



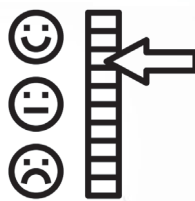




What are the Goals?



Survey



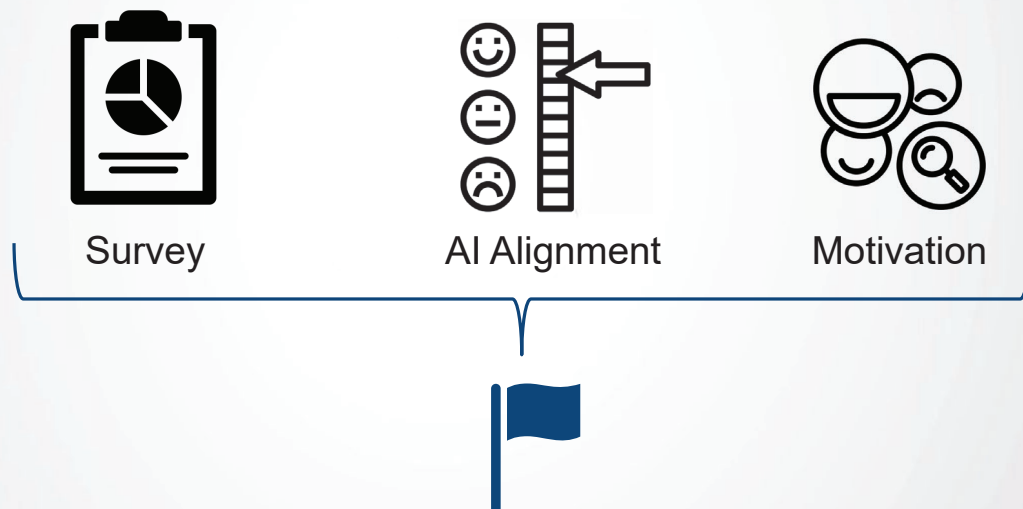
AI Alignment



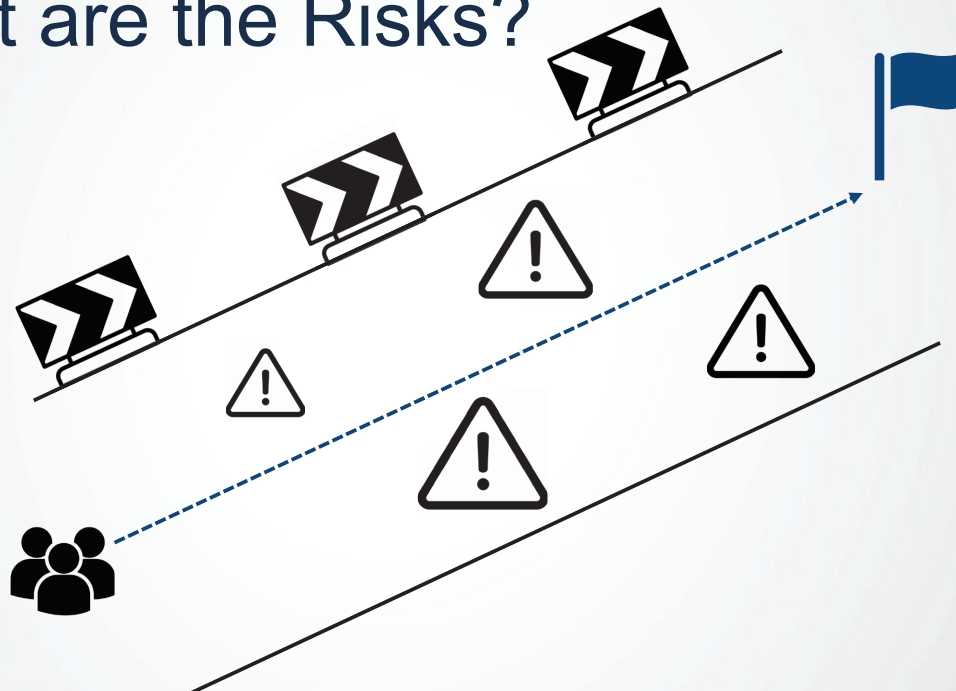
Motivation



What are the Goals?



What are the Risks?



Open Forum



Leaders



Engineers



Operations



IT



Policy Makers



AI-Augmented Bid Evaluation



Recommending an under-qualified bidder (hallucination)



Favoring certain bidders due to data bias



Decreased critical thinking



Risk Assessment

Outcome
Of Event

Likelihood of Event



Risk Assessment

- 4 – Very Likely
- 3 – Likely
- 2 – Somewhat Likely
- 1 – Unlikely

Likelihood of Event



Risk Assessment

Outcome
Of Event ↑

- 4 – Catastrophic
- 3 – Severe
- 2 – Moderate
- 1 – Minimal



Risk Rating

Outcome
Of Event ↑

4	8	12	16
3	6	9	12
2	4	6	8
1	2	3	4

Likelihood of Event →

Low Risk

Medium Risk

High Risk



Risk Rating

	Unlikely	Somewhat Likely	Likely	Very Likely
Catastrophic	4	8	12	16
Severe	3	6	9	12
Moderate	2	4	6	8
Minimal	1	2	3	4

Low Risk
Medium Risk
High Risk



Open Forum



Leaders



Engineers



Operations



IT



Policy Makers

- Show of Hands
- Keep meeting minutes
- Develop action items





Open Forum



Leaders



Engineers



Operations



IT



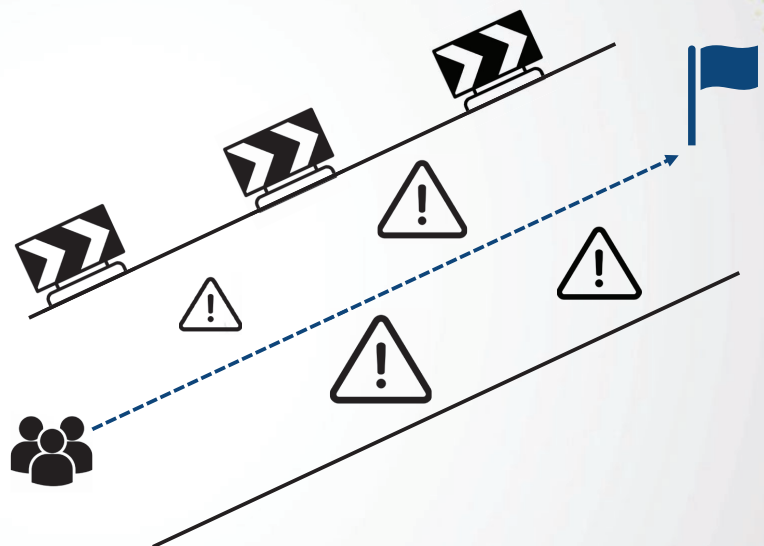
Policy Makers

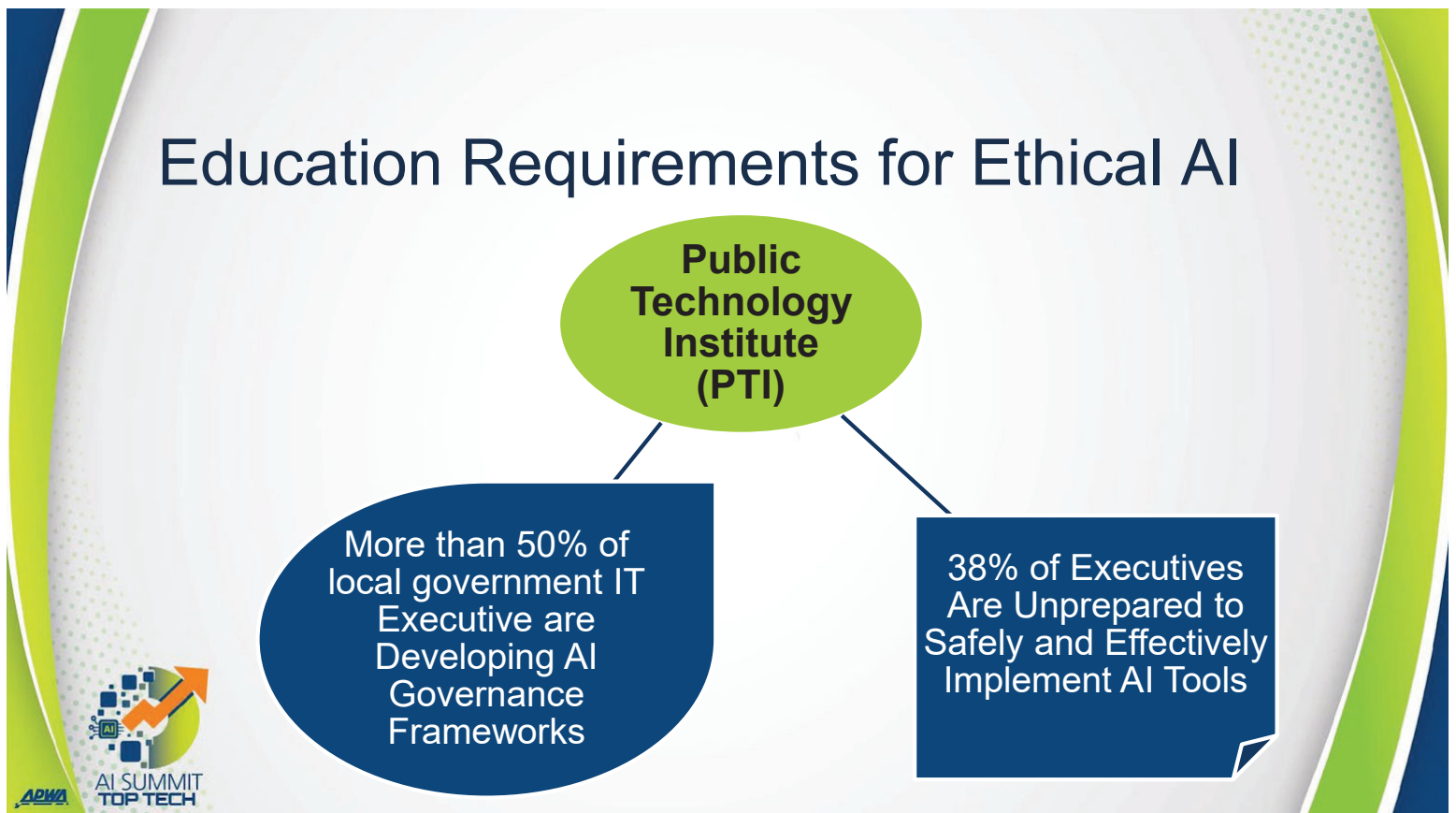
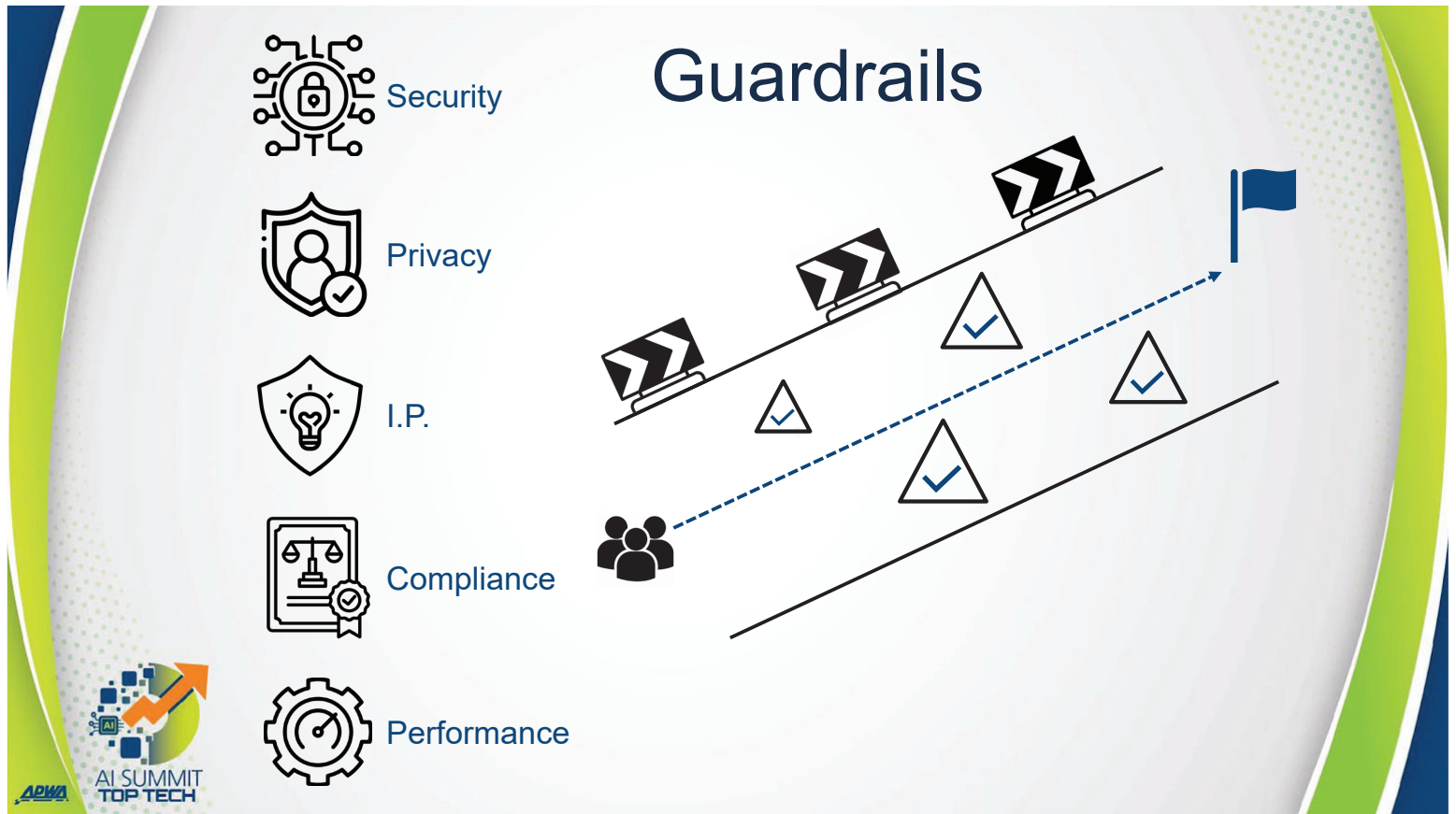


- Show of Hands
- Keep meeting minutes
- Develop action items

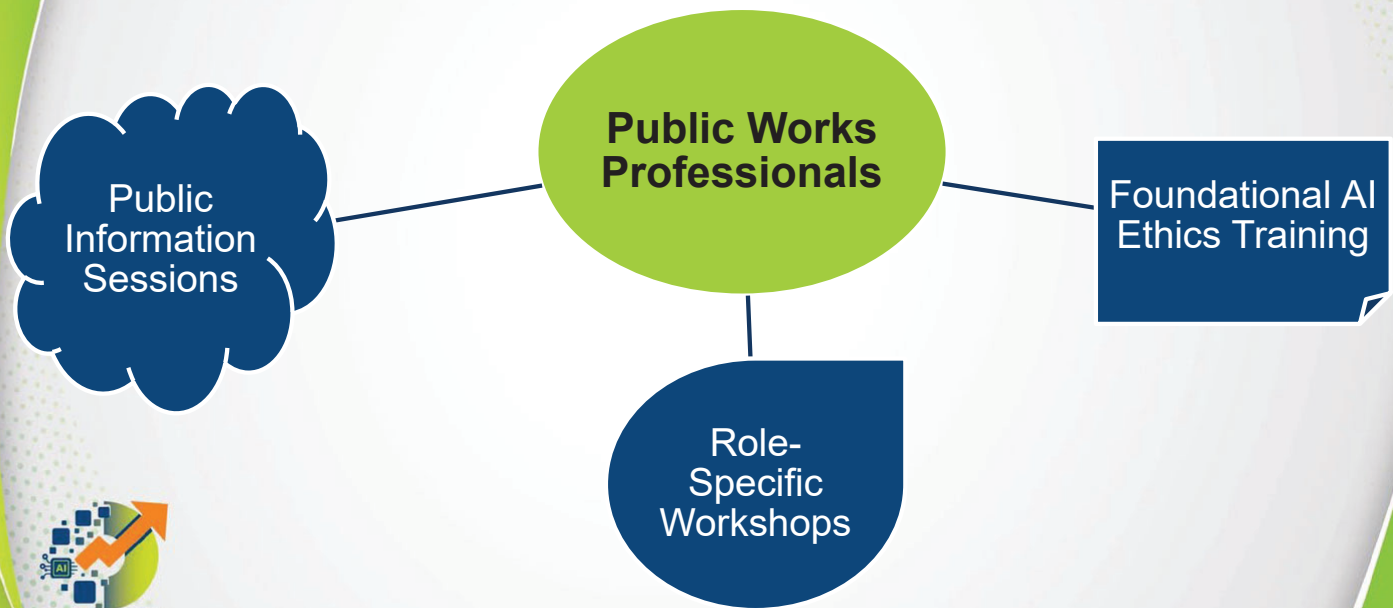


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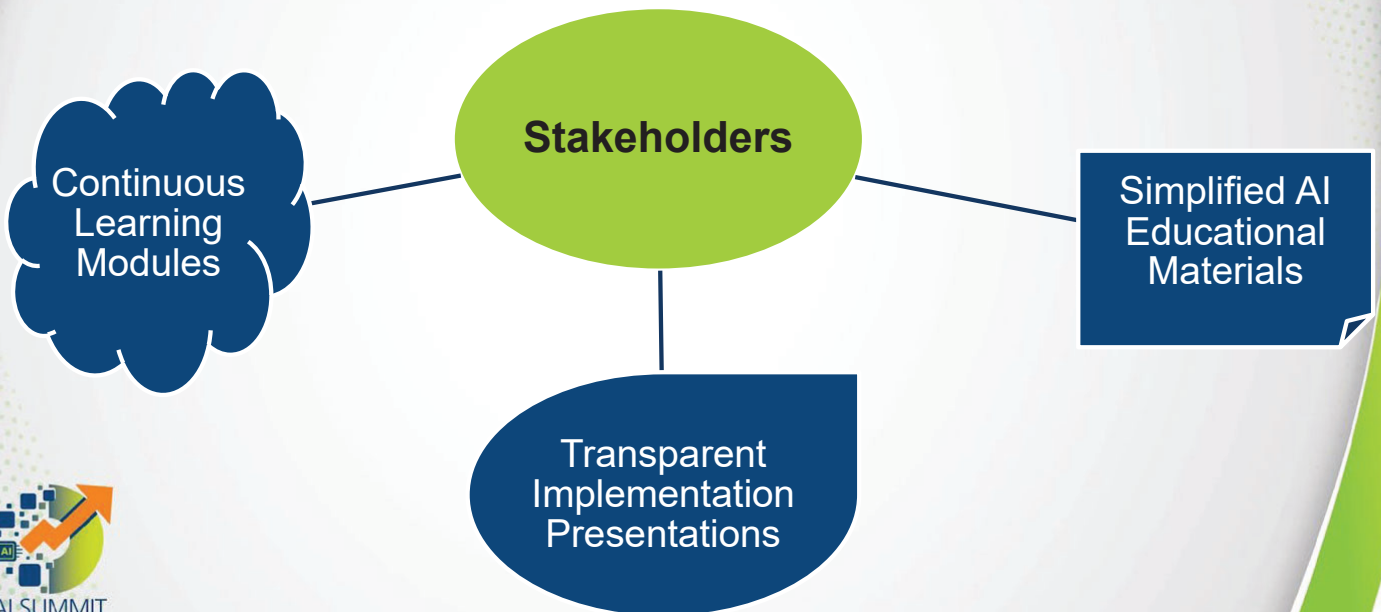




Education Requirements for Ethical AI



Education Requirements for Ethical AI



Implementing Educational Strategies

Interactive Workshops and Seminars

Hands-on learning
Explore AI applications
Build transparency, trust

Collaborative Policy Development

Engage diverse stakeholders
Address ethical concerns
Foster shared ownership

Feedback Mechanisms

Gather continuous input
Improve privacy, accessibility
Align with expectations



POLL QUESTION

- Does your organization currently have educational training regarding the use of AI?
- Answer Options:
 1. Yes, we have comprehensive training programs.
 2. Yes, but training is limited or in development.
 3. No, but we are planning to implement training.
 4. No, and there are no plans to implement training.



Educational Resources

- AI Federal Leadership Program
- GovAI Coalition
- InnovateUS AI Training
- GSA AI Training Series
- AI Academy: American Infrastructure
- PMI AI and Project Management Trainings



Balancing AI Innovation Responsibility

- Recognizing the Need for Responsible Innovation
- Aligning AI Adoption with Organizational Values
- Ensuring Continuous Alignment and Public Trust





Recognizing the Need for Responsible Innovation

- Prioritize Ethical Standards
- Assess Societal Impact
- Mitigate Potential Risks



Aligning AI Adoption with Organizational Values

- Define Core Values
- Integrate Values into AI Strategy
- Establish Ethical Governance

Ensuring Continuous Alignment and Public Trust

- Regular Ethical Audits
- Stakeholder Engagement
- Transparent Communication



Balancing Resistance

Breaking Down
Common
Misconceptions

Fear of replacement
AI automates tasks
Explainable AI transparency

Addressing Employee
Concerns

Reskilling and upskilling
AI as collaboration
Routine tasks handled

Building Culture of
Trust

Employee pilot programs
Feedback through surveys
Tailored AI solutions



Conclusion



Key takeaways

Prioritize Ethical AI: Address ethical and legal considerations for responsible implementation

Engage and Educate: Promote active involvement in education and policy development

Foster Trust: Manage resistance with transparency and inclusion to build collaboration

Collaborate and Adapt: Work across agencies and stay informed to integrate advancements



Q&A

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We look forward to seeing you
tomorrow at 10 am CT



Chris Ewell
Assistant Public Works Director
Facilities Management
City of Phoenix