United States
Department of Energy
National Nuclear Security Administration
International Nuclear Security

Artificial Intelligence

Applications to and Implications for Nuclear Security
Alan Evans – Sandia National Laboratories

- Introduction to the Role of Artificial Intelligence in Strengthening the Security of Nuclear Facilities| February 6-8, 2024 | Vienna, Austria

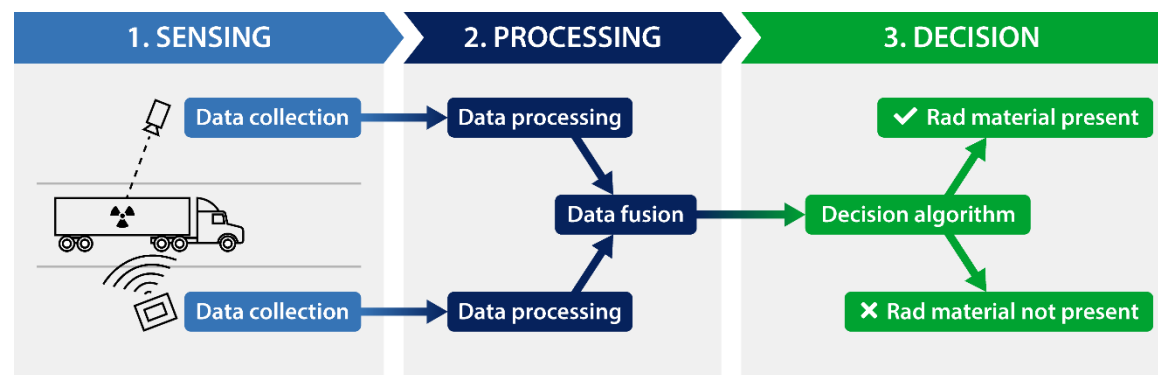ORNL Document 168343

Goals

Data fusion

What is it?

Artificial intelligence-driven data fusion

Why data fusion?

What are the vulnerabilities introduced?

1. What is data fusion?

Discovering and exploiting complex relationships among data collected by multiple sensors

Poll Question:

What types of sensors do you regularly use for physical protection?

1. Video cameras
2. Badge readers
3. Infrared cameras
4. Radiation detectors
5. Seismic sensors
6. Infrasound sensors
7. Proximity sensors
8. Light sensors

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Can we change the performance of protection systems by combining data from multiple sensors?

*What would we want to use data fusion for?*

Which of these is a threat?

- Q: What type of information would you need to make this determination?

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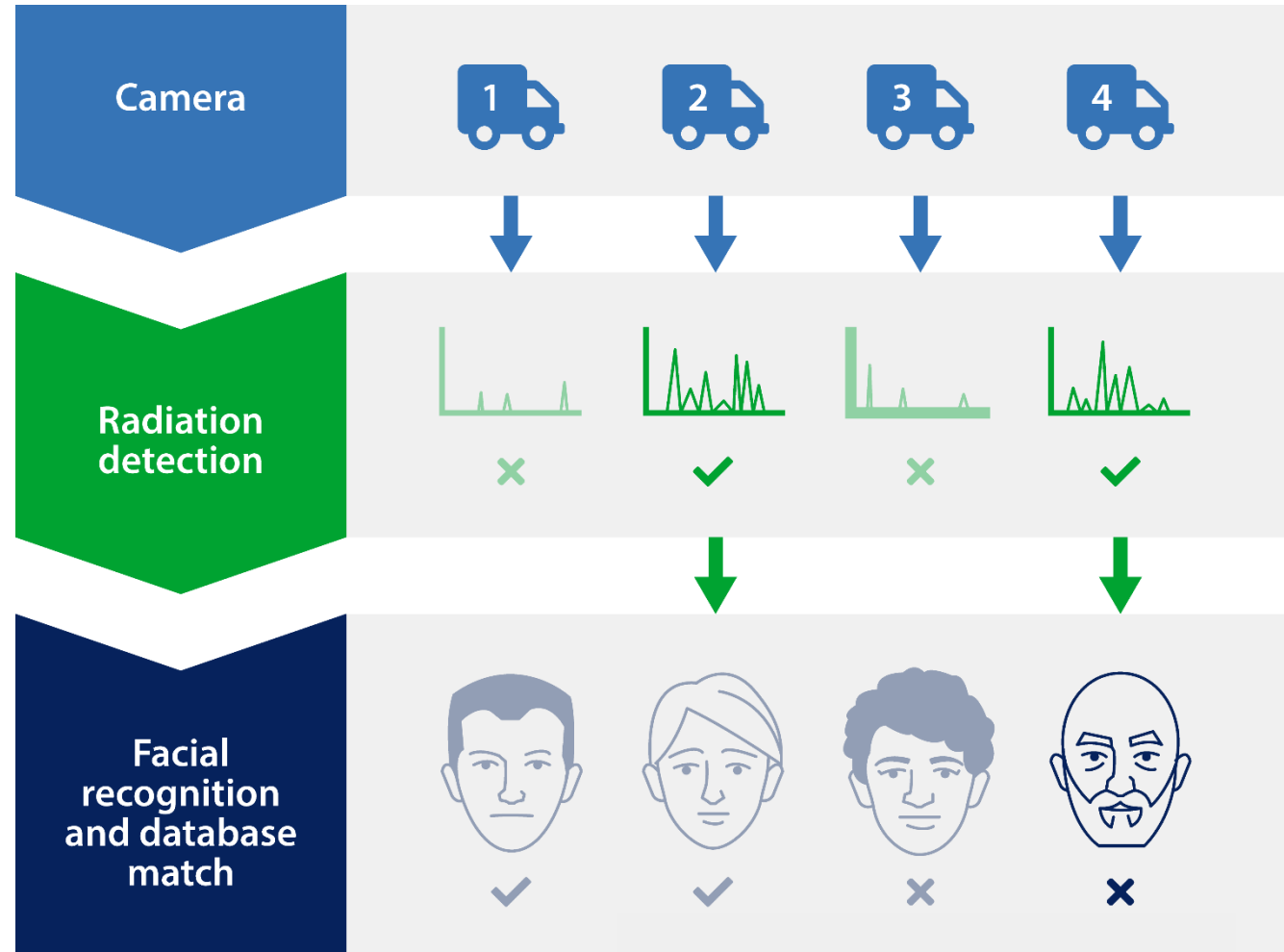
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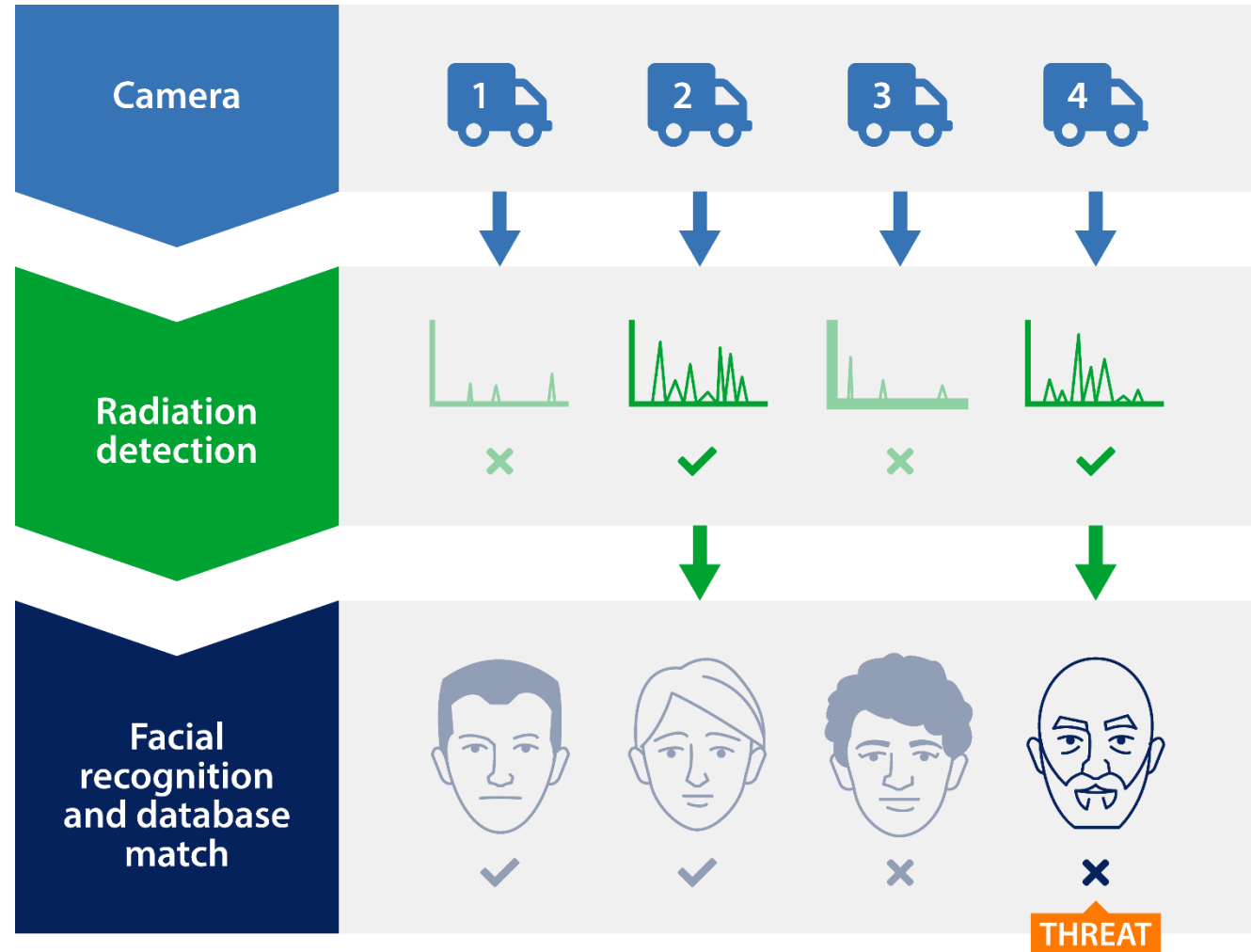
How do we use data fusion?

What is a data fusion system?

1. Sensors produce data
2. Data processors produce features
3. Decision algorithms produce labels
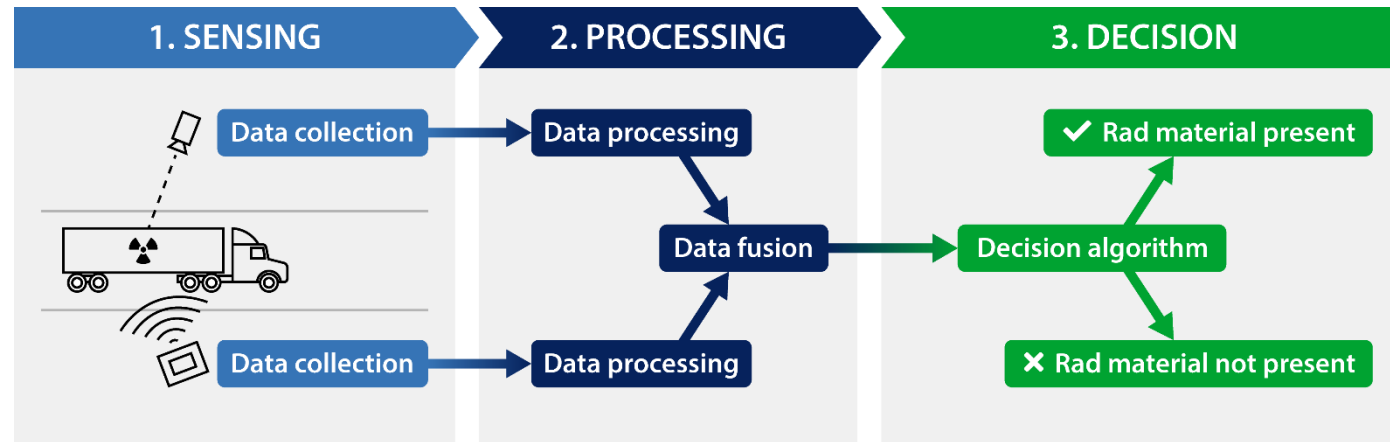
What is driving data fusion?

- Lighter, less expensive, more portable sensors
- Smaller computing systems
- Larger computing power

What are the added challenges?

- System maintenance
- System security
- Verification and Validation

2. How can data fusion alter the performance of a protection system or decision support system?

Improves confidence and resilience

Enables sophisticated conclusions
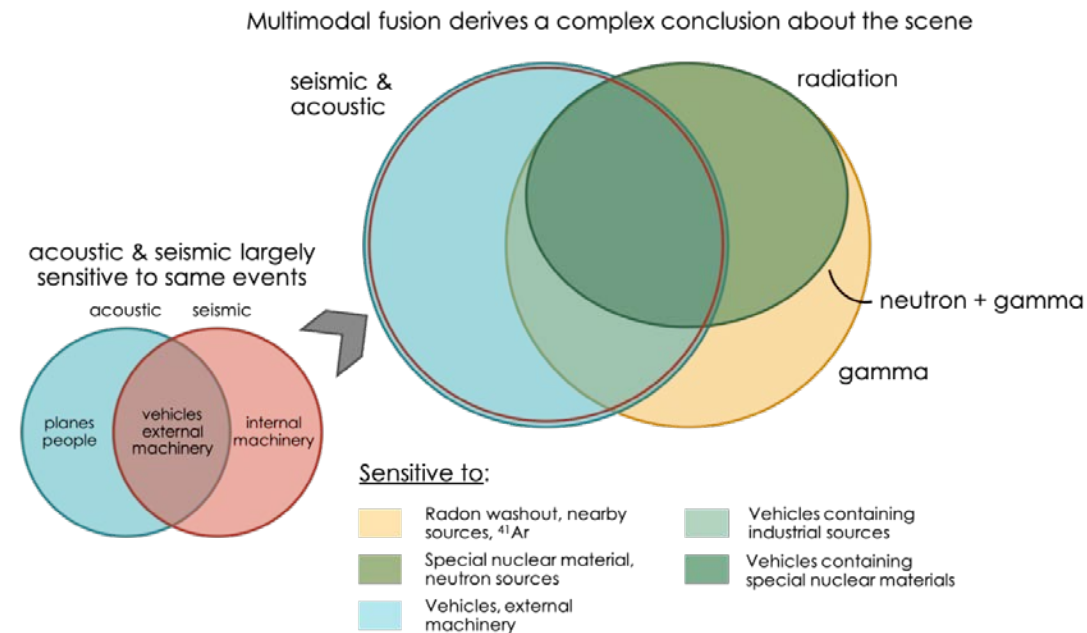
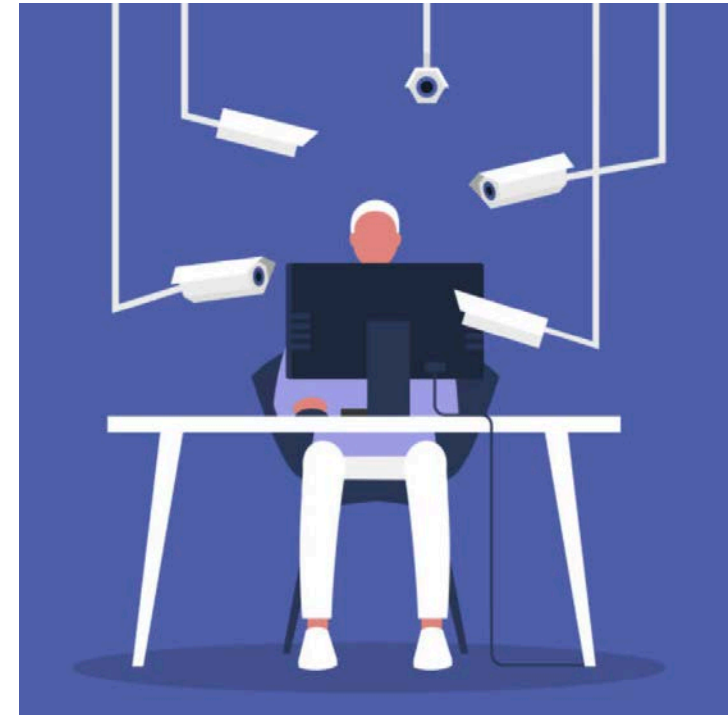# Data fusion can …

Data fusion can …

- Build in redundancies
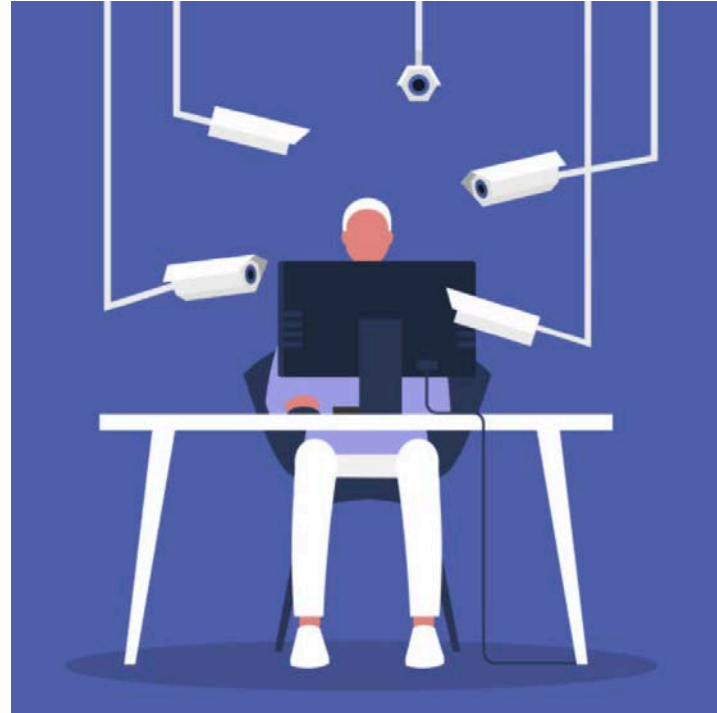
Working from Home

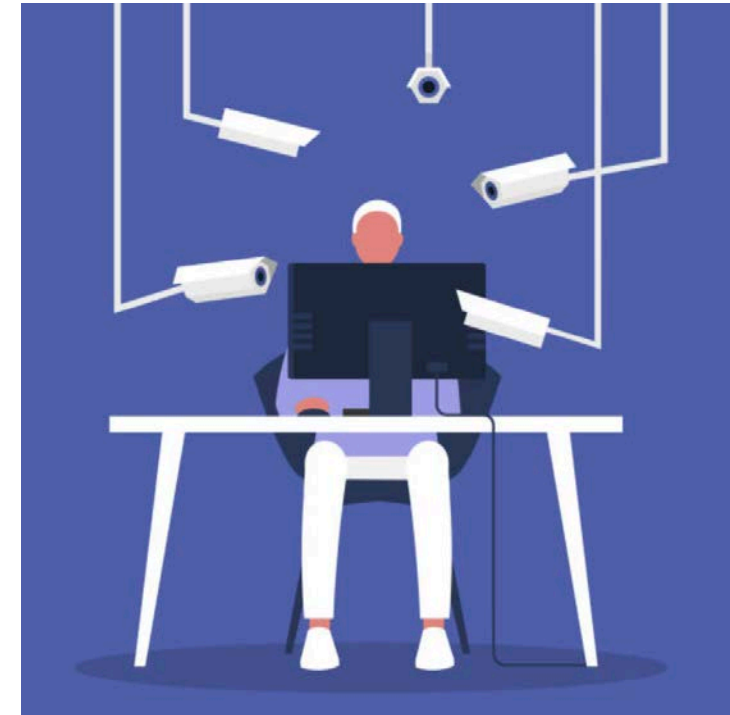# Data fusion can …

- Build in redundancies

Multiview
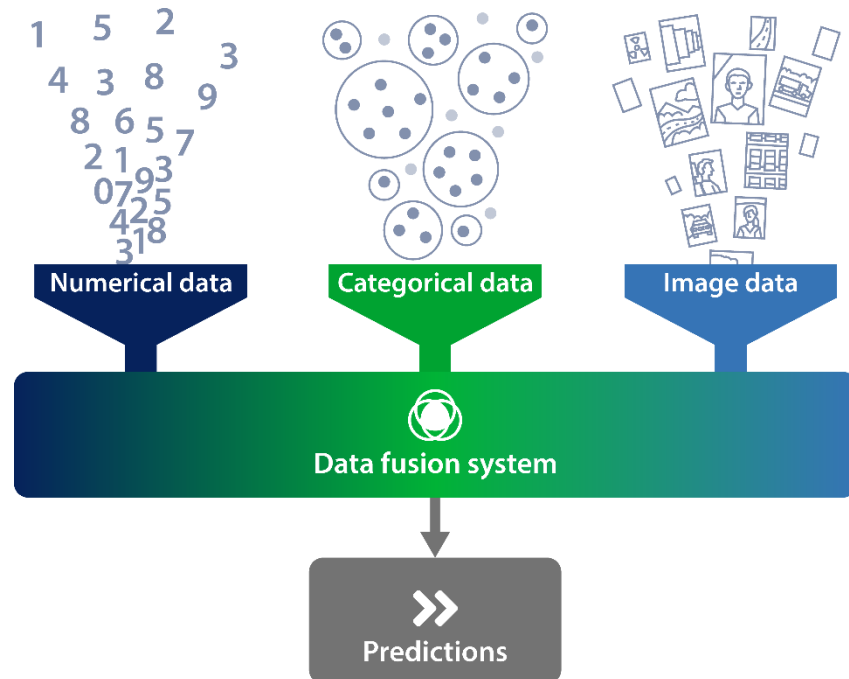

Working from Home

Data fusion can …

Multiview

- Build in redundancies

Working from Home

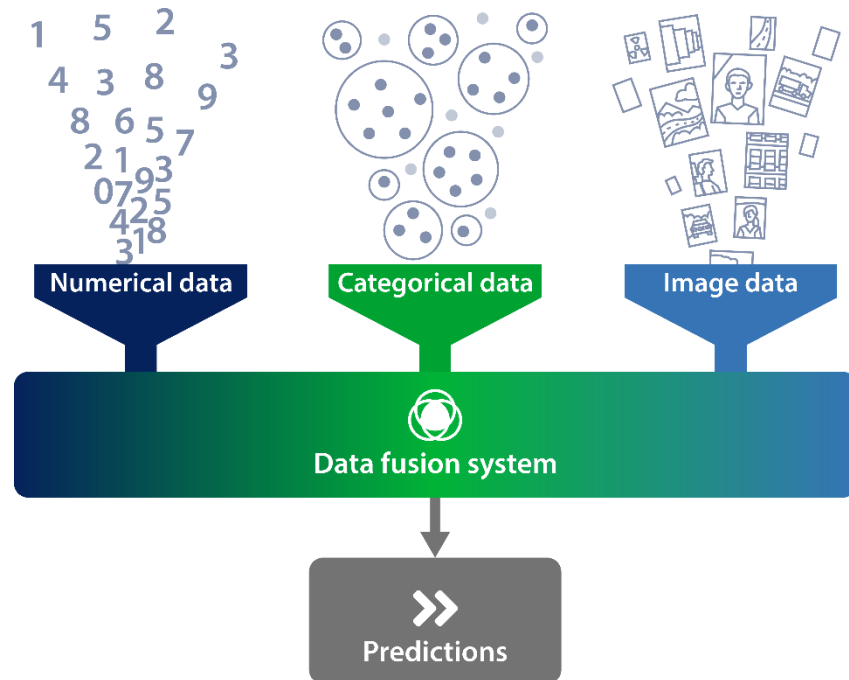**Improves confidence and resilience in decision-making capabilities**

Data fusion can …

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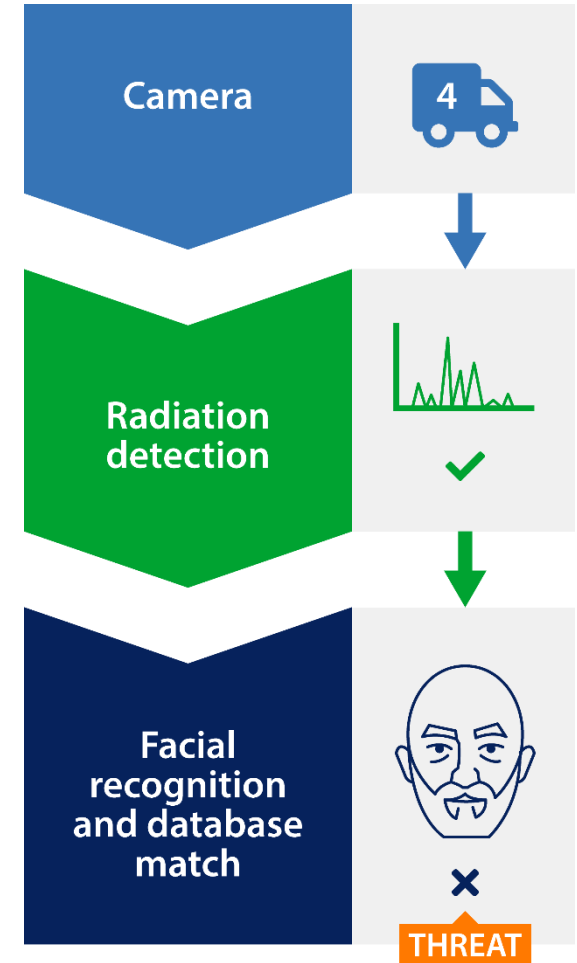
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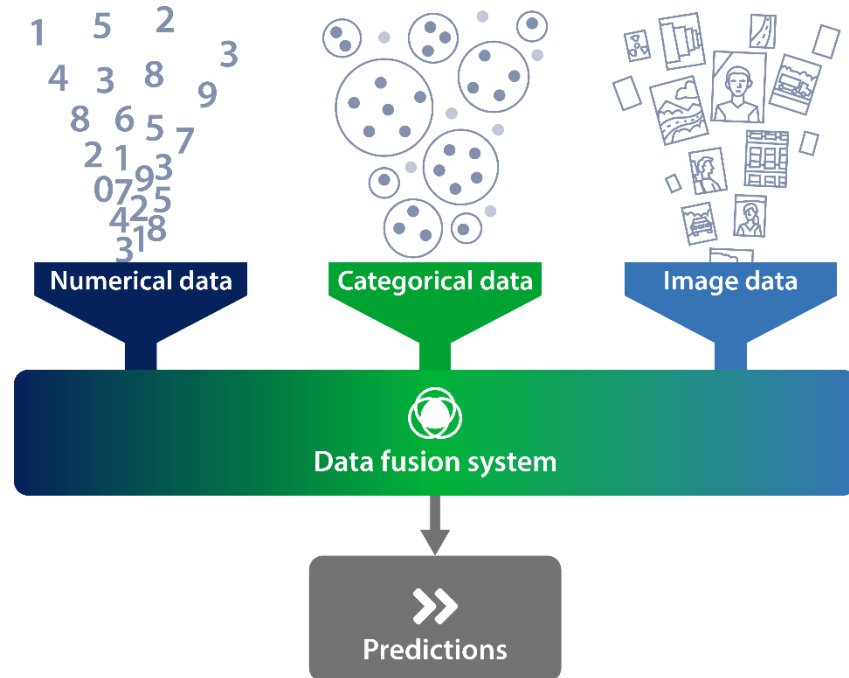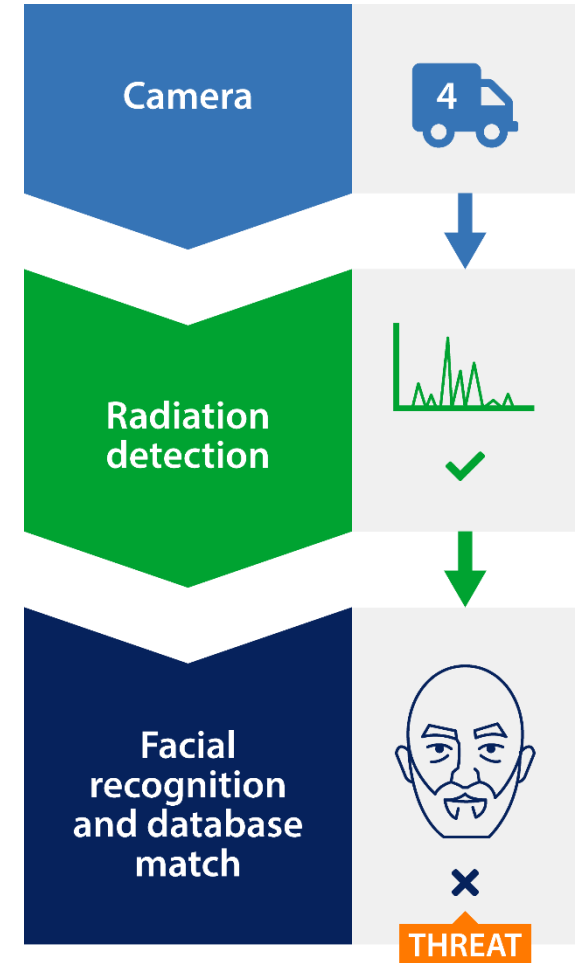- Handle different types of data

Multimodal

Camera

Radiation detection

Facial recognition and database match

THREAT

Data fusion can …

- Build in redundancies
- Handle large amounts of different types of data when enabled by AI
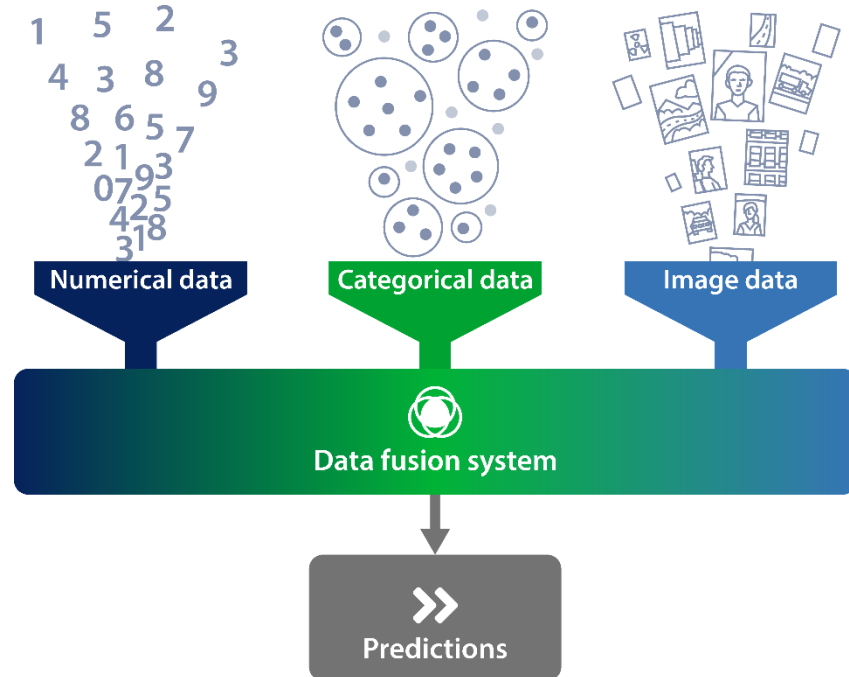

Multimodal

Data fusion can …

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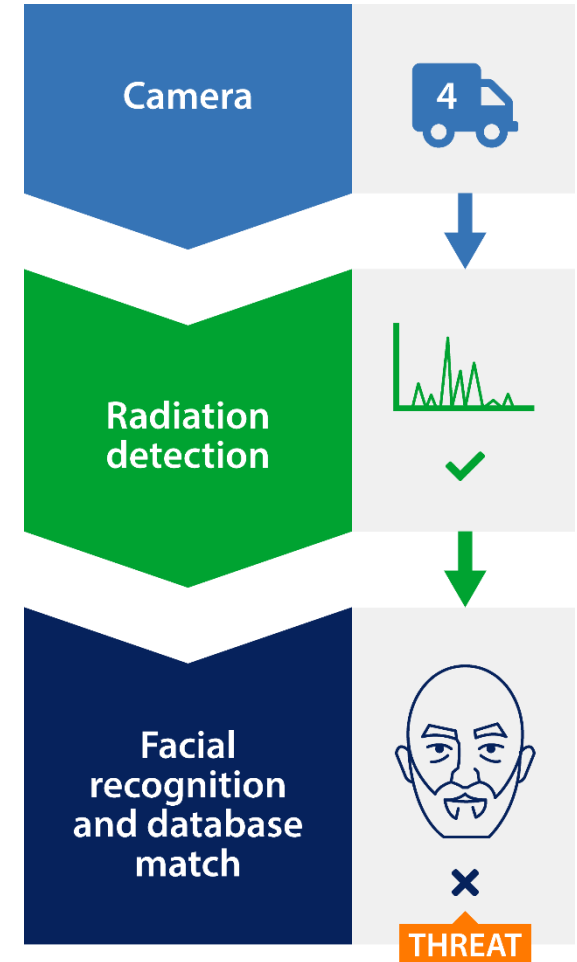- Handle large amounts of different types of data when enabled by AI

Multimodal

Improves complexity in derived decisions

Data fusion can draw sophisticated solutions

Manually Designed Fusion

AND Truth Table

Relies on experts to encode decision rules

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Manually Designed Fusion

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AI-Based Fusion
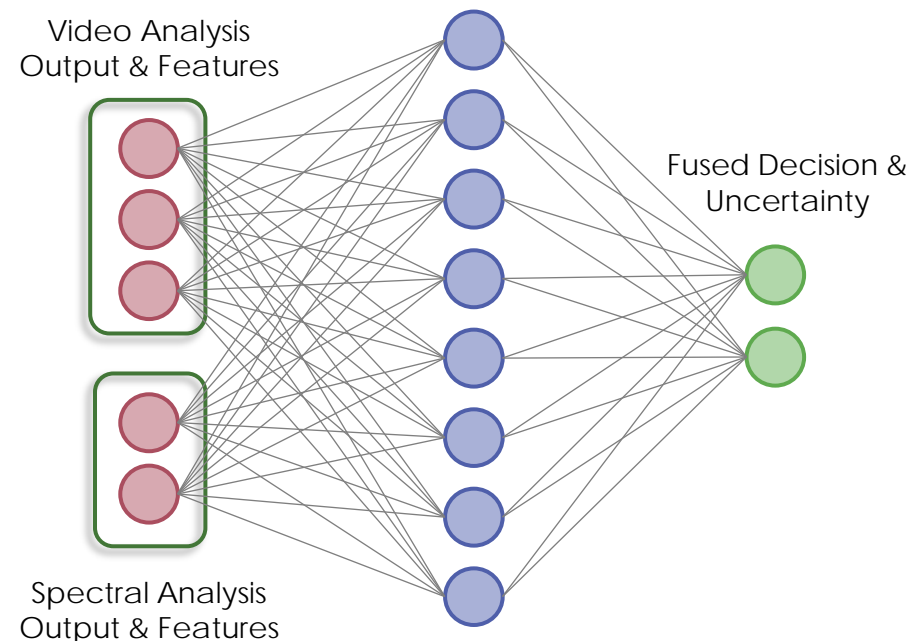
Complex relationships are learned

Summary

- Ubiquity of sensors and widespread computing power make AI-driven data fusion possible

- Fusion systems may be designed to be more robust than single-sensor systems and draw more complex conclusions about the scene

Questions