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NOW MATTERS

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AI AND CYBERSECURITY

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN SECURITY
UNDERSTANDING AND DEFENDING AGAINST ADVERSARIAL AI

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Agenda

Three perspectives on AI and Security:

1. CISO: AI for cyberdefense

2. Attacker: using and attacking AI for fun and profit

3. R&D: making AI more robust

CISO PERSPECTIVE: AI FOR CYBERDEFENSE

What CISOs are facing

COMPLIANCE MANDATES

GDPR fines can cost

billions

for large global companies

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SKILLS SHORTAGE

By 2022, there will be

1.8 million

unfulfilled cybersecurity positions

What CISOs are facing

COMPLIANCE MANDATES

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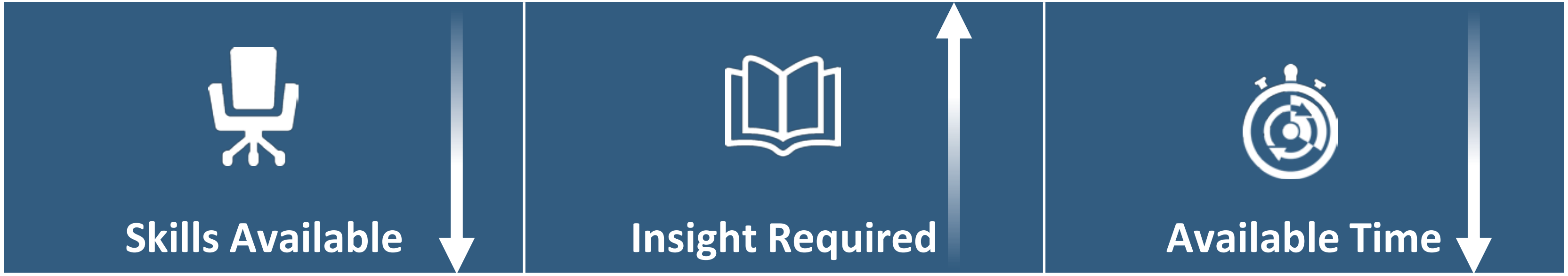
TOO MANY TOOLS

Organizations are using

too many

tools from too many vendors

What motivates the rush on AI for security?



Skills Available

Insight Required

Available Time

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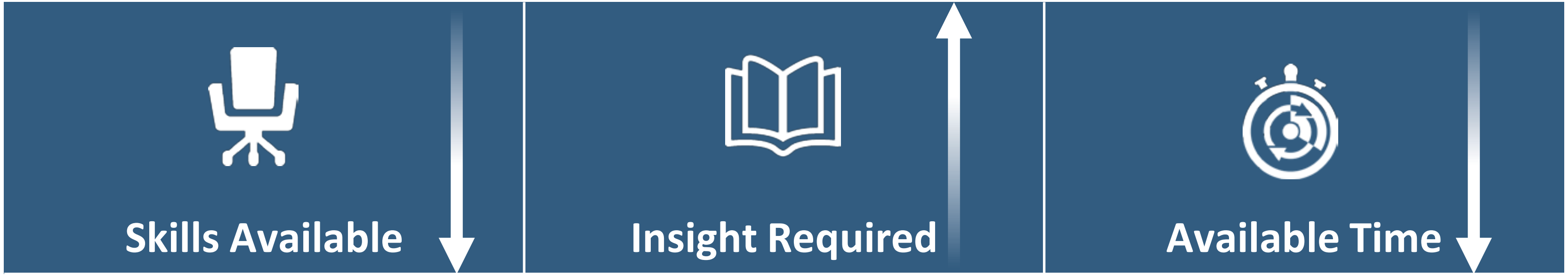

Skills Available

Insight Required

Available Time

Skills

- Sophistication of tools
- Evolution of the threat
- Lack of best practices

Insight

- Complexity of context
- Lack of insights
- Insufficient data

Speed

- Attacks move faster
- Shortening disclosure timeframes

Using AI to address growing security needs

Predictive Analytics

Intelligence Consolidation

Trusted Advisors & Response

Using AI to address growing security needs

Predictive Analytics

- **Approach**: Model behaviors and identify emerging and past threats and risks
- **Applications**:
  - Network threats
  - User behavior
  - Endpoint threats / malware
  - Application testing
  - Data access patterns

Intelligence Consolidation

Trusted Advisors & Response

Using AI to address growing security needs

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Intelligence Consolidation

- **Approach**: Curation of intelligence and contextual reasoning
- **Applications**:
  - Open Source TI
  - Security Research
  - Regulatory documents

Trusted Advisors & Response

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Trusted Advisors & Response

- **Approach:** Reason about security events for triage and response
- **Applications:**
  - Automated forensics
  - Case analysis
  - Case preparation
  - Automated response

ATTACKERS: AI FOR FUN AND PROFIT

Attackers: AI for fun and profit

AI Powered Attacks

Attacking AI

Theft of AI

Attackers: AI for fun and profit

AI Powered Attacks

- Generating new attacks
- Automating large scale attacks
- Refining existing attacks
- Evading defenses (generative adversarial networks)

Attacking AI

Theft of AI

Attackers: AI for fun and profit

AI Powered Attacks

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Attacking AI

- Poisoning models
- Evade AI powered defenses
- Harden attacks (reinforcement learning etc.)

Theft of AI

Attackers: AI for fun and profit

AI Powered Attacks

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Attacking AI

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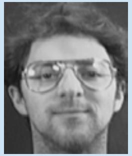
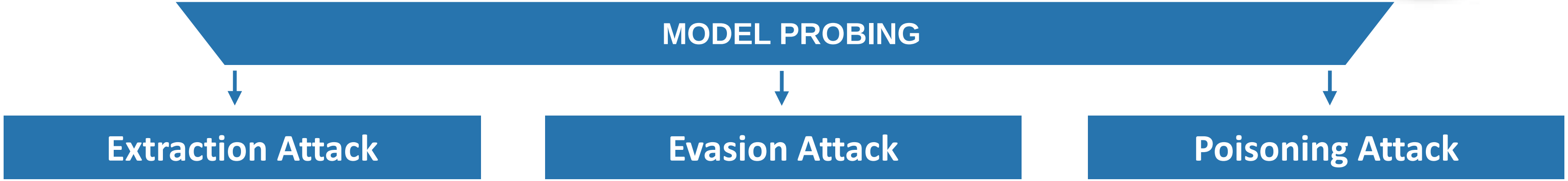
Theft of AI

- Theft of models
- Transfer attacks
- Privacy (model inversion)



Attacks against AI: Security threats for AI APIs



MODEL PROBING

Extraction Attack

Evasion Attack

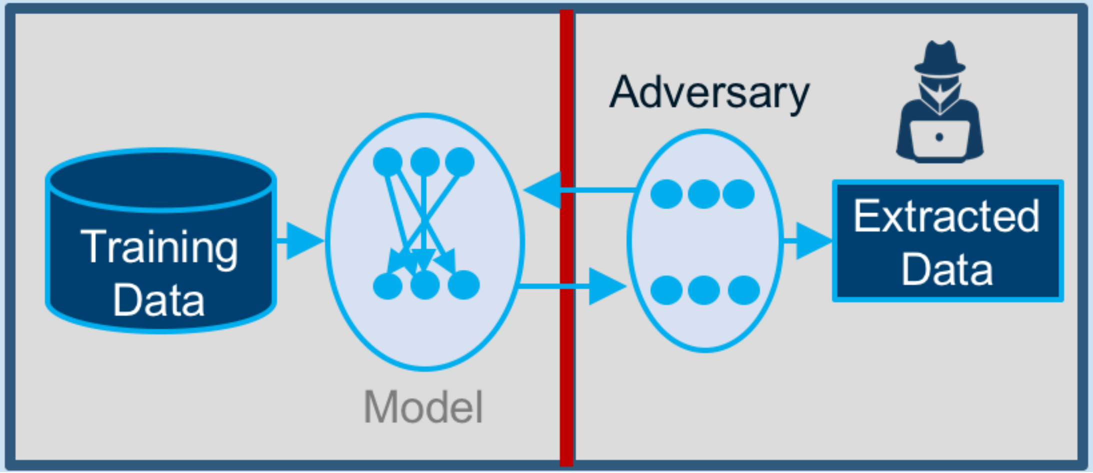
Poisoning Attack

Attacks against AI: Security threats for AI APIs

MODEL PROBING

Extraction Attack | Evasion Attack | Poisoning Attack

- Adversary extracts model and proprietary training data information
- **Vulnerable domain**
  Models that provide insights from proprietary data
  - E.g., Extract sensitive confidential information from training data



Attacks against AI: Security threats for AI APIs

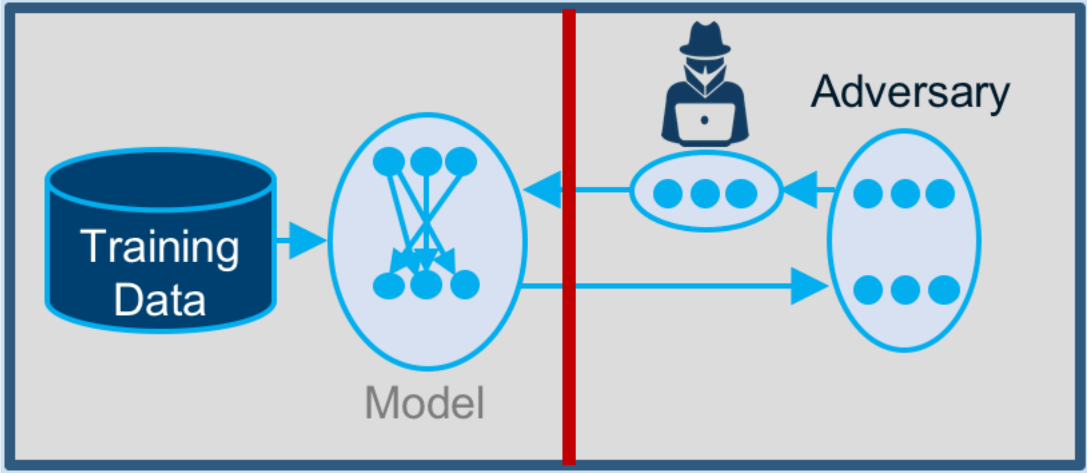
MODEL PROBING

Extraction Attack

Evasion Attack

Poisoning Attack

- Exploit model blind spots to mislead or fool the model
- **Vulnerable domain** Models used in screening or supervisory functions
  - E.g., Minimally perturb images to bypass image recognition service



Attacks against AI: Security threats for AI APIs

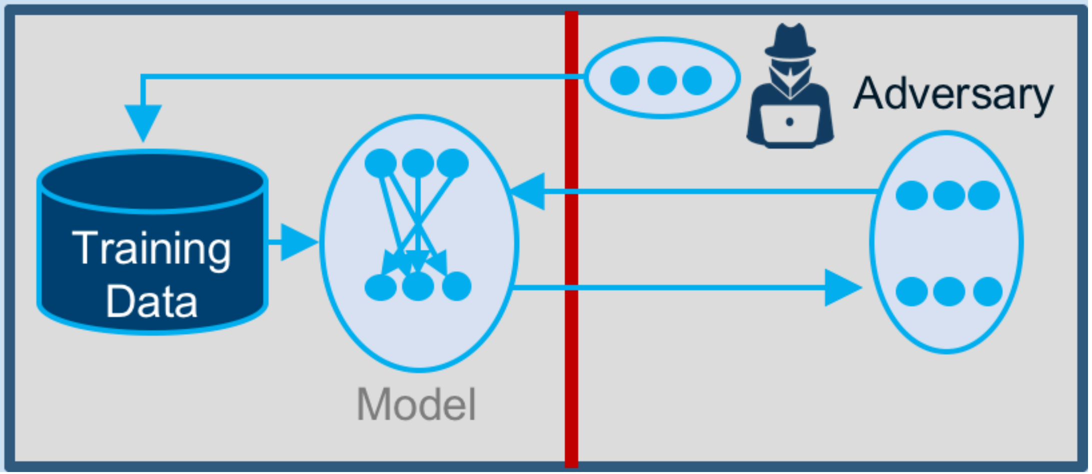
MODEL PROBING

Extraction Attack

Evasion Attack

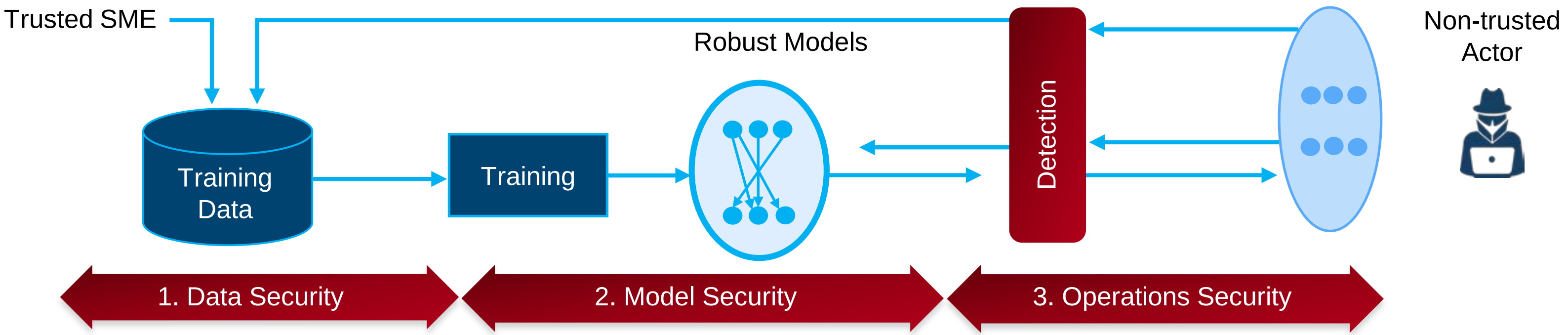
Poisoning Attack

- Corrupt model by manipulating training data to shift underlying model
- **Vulnerable domain**
  Any model that is basedon active / online learning
  - E.g., Corrupting a chat bot through interaction



Attacks against AI: Countermeasures

Data Security	**Ground truth protection:** process and enrich training data to protect privacy and increase robustness
Model Security	**Robust models:** Techniques and algorithms for resilient models by construction
Operations Security	**Threat detection:** Detect and eliminate adversarial inputs during production use



RESEARCH: MAKING AI MORE ROBUST

Adversarial Robustness Toolbox (ART)

Announcing:

ART – an **open-source library** for **adversarial machine learning**

- ART provides an implementation for many state-of-the-art methods for attacking and defending classifiers
- ART allows rapid crafting & analysis of attacks and defense methods for machine learning models

https://github.com/IBM/adversarial-robustness-toolbox

Adversarial Robustness Toolbox (ART)

Attack methods	Defense methods
• Deep Fool (Moosavi-Dezfooli et al., 2015) • Fast Gradient Method (Goodfellow et al., 2014) • Jacobian Saliency Map (Papernot et al., 2016) • Universal Perturbation (Moosavi-Dezfooli et al., 2016) • Virtual Adversarial Method (Moosavi-Dezfooli et al., 2015) • C&W Attack (Carlini and Wagner, 2016) • NewtonFool (Jang et al., 2017)	• Feature squeezing (Xu et al., 2017) • Spatial smoothing (Xu et al., 2017) • Label smoothing (Warde-Farley and Goodfellow, 2016) • Adversarial training (Szegedy et al., 2013) • Virtual adversarial training (Miyato et al., 2017)

https://github.com/IBM/adversarial-robustness-toolbox

ART DEMONSTRATION

Apply What You Have Learned Today

- In the next week:
  - **Understand and educate** your team about AI for Security vs Security for AI;
  - Experiment with basic AI models
- In the first three months:
  - **Kick off a security analytics projects** to get unique insights and take action
  - Identify the data sources i.e. SIEM data, Data activity monitoring, IAM data, etc.
  - Identify scenarios of interest. i.e. where the sensitive data is, who is accessing what, what systems are more vulnerable, what are patterns of frequent attacks, etc.
- Within six months leverage:
  - **Leverage the ART toolkit** to help improve robustness of AI models
  - Mature the analytics project with AI powered orchestration