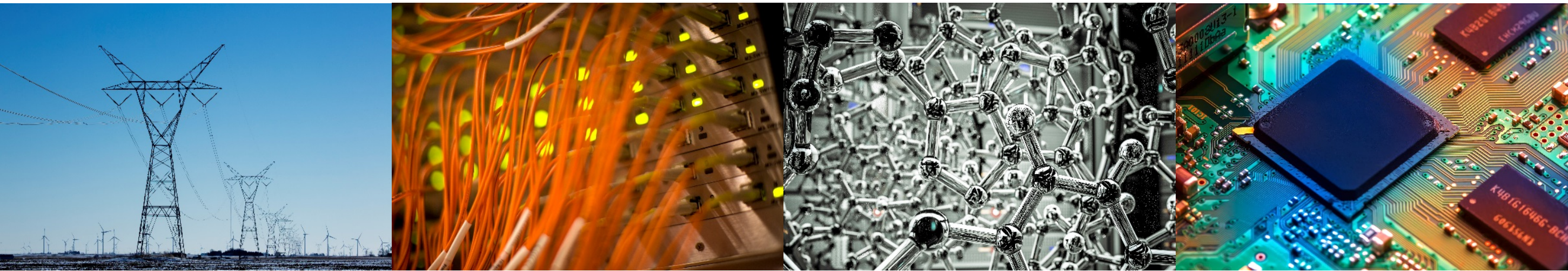


Data Provenance for Accountability Mechanisms and Properties

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using Provenance (SAAP) — Opportunities and Challenges
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Motivation

- “Accountability” has various definitions
 - NIST: “actions of an [agent] [that can] be traced uniquely to that [agent]” that supports “nonrepudiation, deterrence, fault isolation, intrusion detection and prevention, and after-action recovery and legal action”
- Difficult to formalize
 - Kacianka et al. study¹ from 2017: “20 of the 45 papers provide **no explicit definition of accountability**. 17 papers provide their **own definition**, not taking other sources into account.”

1. Kacianka et al. “How Accountability is Implemented and Understood in Research Tools: A Systematic Mapping Study” in *Proceedings of PROFES 2017*, LNCS 10611.

Motivation

- Provenance has been put forth as a way of demonstrating accountability
 - Moreau and Groth² from 2013: “Provenance is a substrate that can be used to perform policy checks and to make systems *accountable*”
- **How has accountability been formalized? (mechanisms, properties)**
- **How can we relate it to data provenance?**
- **What are the relevant challenges for data provenance?**

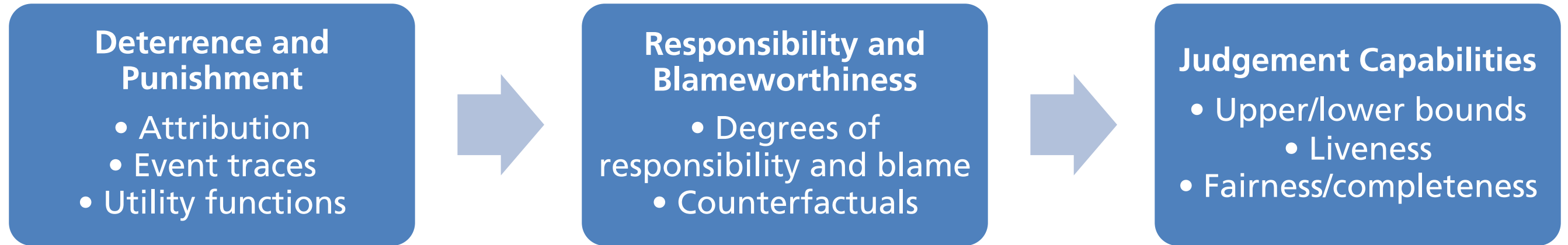
2. Moreau and Groth. *Provenance: An Introduction to PROV*, Morgan & Claypool, 2013.

Accountability Mechanisms

- **Binds a system's states and events to identities of agents or principals within a system**
- **Provides validation and compliance mechanisms either during operation or after the fact to ensure correctness of intended behavior or acceptable standards**
- **Ensures the integrity of records about past events when agents misbehave**

3. Yumerefendi and Chase. "The role of accountability in dependable distributed systems" in *Proceedings of Hot Topics on Dependability, USENIX, 2005*.

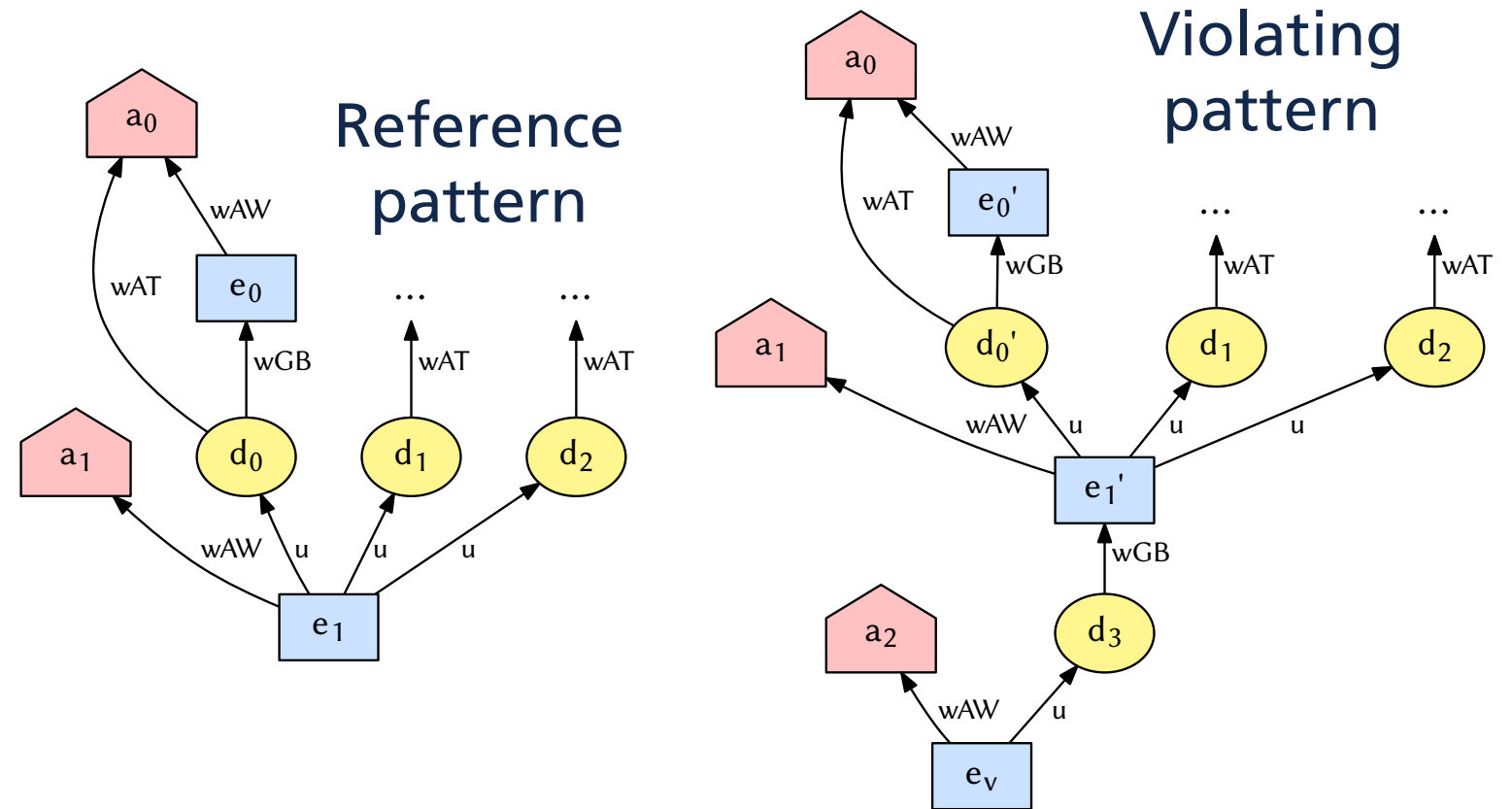
Accountability Properties



- Feigenbaum et al. (2011): accountability as **quantifying punishment**
- Chockler and Halpern (2004): accountability as a causality problem involving degrees of **responsibility** and **blame**
- Jagadeesan et al. (2009): accountability as the capability of **judging blame**
- Küsters et al. (2010): accountability properties of **fairness** and **completeness** in protocol design

Data Provenance Challenges

- Reconciling PROV with accountability
- Semantic gaps (e.g., responsibility, attribution)
- Dependencies and modeling
- Causality analysis needs reference events and patterns



Future Work

- **Study provenance link to accountability with greater formality about how to define accountability**
- Systems building: Being able to collect provenance is non-trivial
- Modeling: Capturing provenance relative to the system in question and what kinds of questions it should be able to answer
- Analysis: Provenance metrics for responsibility and blame

Questions?

- Thanks for listening!
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