An Event-Based Digital Forensic Investigation Framework

By

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DFRWS 2004

Outline

- Basic concepts
- The big picture of investigations
- Digital crime scene investigation
- Summary

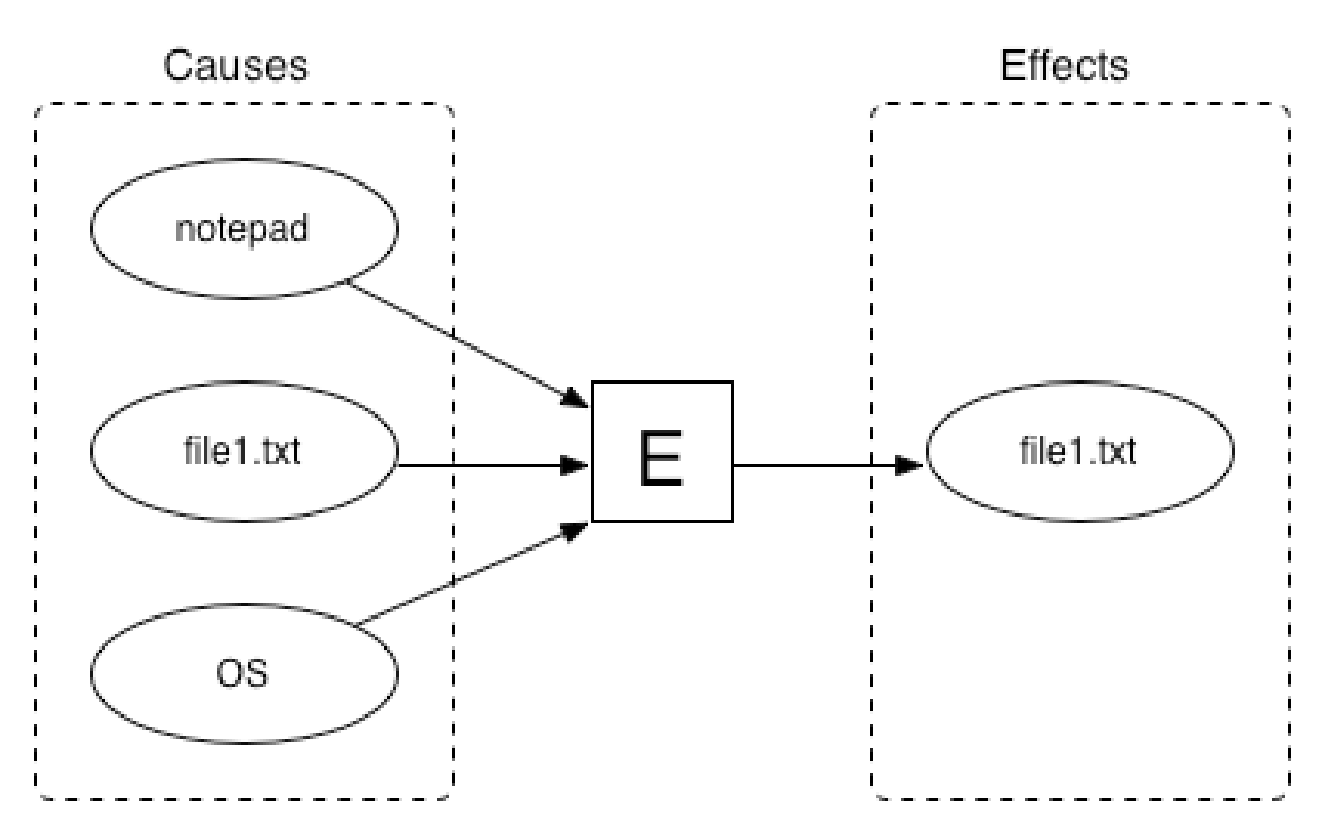
Digital Data & Objects

- **Digital data**: Data represented in a numerical form
- **Digital object**: A discrete collection of digital data
- All digital data has a physical form
  - Magnetic Fields
  - Voltage Levels

States & Events

- **State:** The value of an object's characteristics
- **Event:** An occurrence that changes the state of one or more objects
  - Cause: An object whose state was used by the event
  - Effect: An object whose state was changed by an event

Basic Event: Appending a File



Incidents & Investigations

- **Incident/Crime**: An event that violates a policy or law
- **Investigation**: A process that develops and tests hypotheses to answer questions about events that occurred

Evidence

- There is evidence of an event if the effect objects still exist
- **Digital Evidence**: A digital object that contains reliable information that supports or refutes a hypothesis about the incident
  - A hard disk is physical evidence

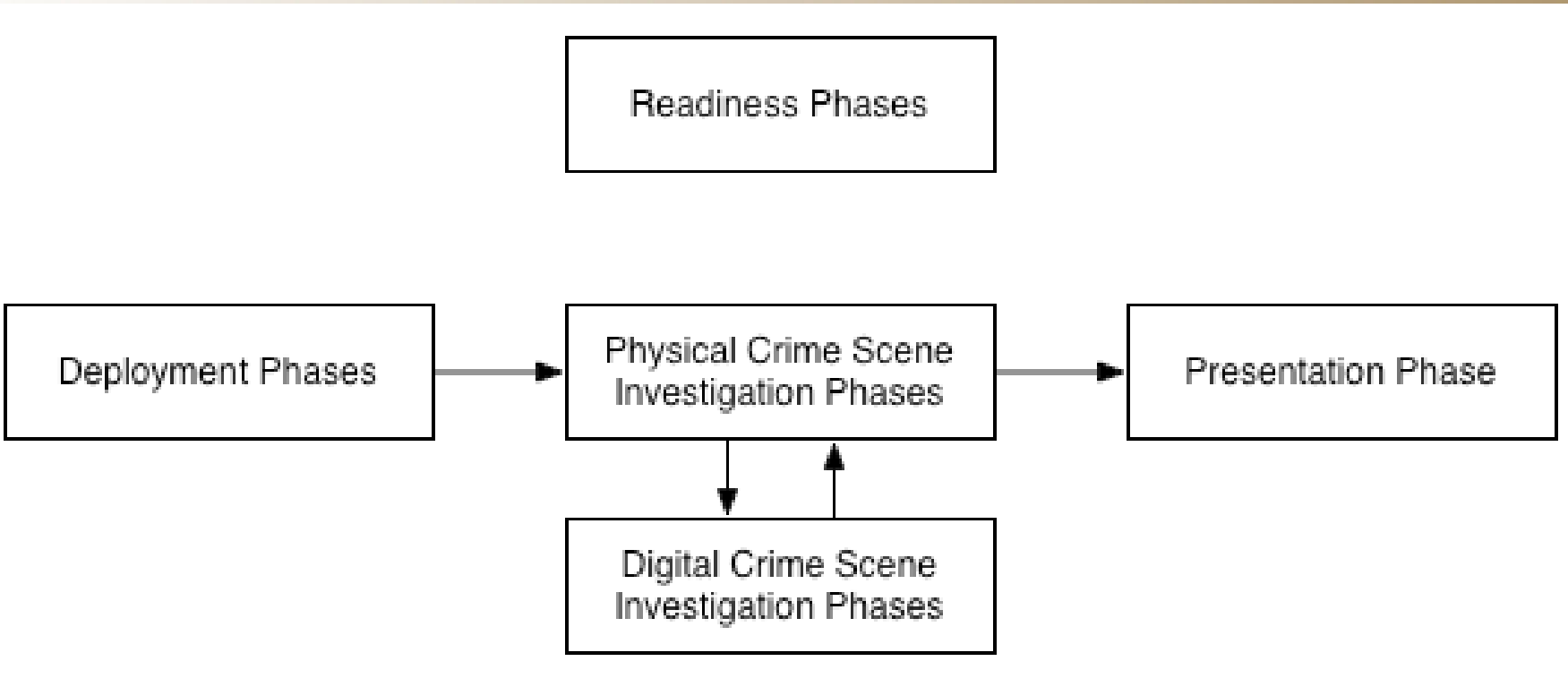
What about "Forensics"?

- "Relating to the use of science or technology in the investigation and establishment of facts or evidence in a court of law"
  - American Heritage Dictionary
- Digital Investigation vs. Digital Forensic Investigation: The legal requirements

Digital Forensic Investigation

A process that uses science and technology to examine digital objects and that develops and tests theories, which can be entered into a court of law, to answer questions about events that occurred.

The Big Picture


Readiness Phases
Deployment Phases
Physical Crime Scene Investigation Phases
Presentation Phase
Digital Crime Scene Investigation Phases

Digital Crime Scene Investigation

Digital Crime Scene Investigation

- Goal: To determine what digital events occurred by recognizing digital evidence
- Three Phases:
  - Crime Scene Preservation & Documentation
  - Evidence Search & Documentation
  - Event Reconstruction & Documentation

Phase 1:

Digital Crime Scene Preservation & Documentation

Scene Preservation & Documentation

- Goal: Preserve the state of as many digital objects as possible and document the crime scene.
- Methods:
  - Shut system down and copy it
  - Unplug from network & kill processes
  - Do nothing

Is it Necessary?

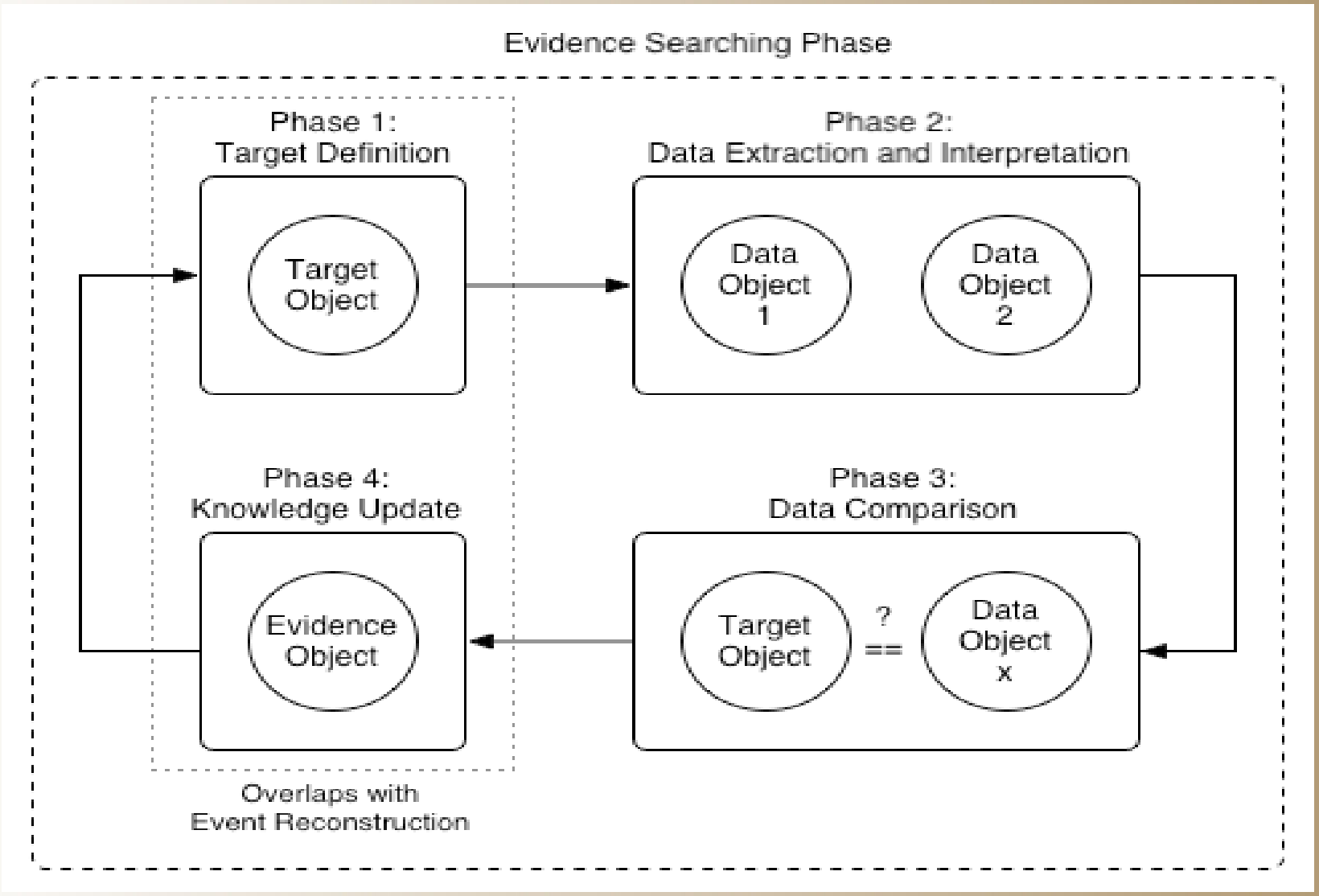
- An investigation does not need preservation
- A forensic investigation may need preservation
- Are bitwise-images needed?
  - Do we take buildings as evidence?
- Legal requirements dictate the technical requirements of this phase

Phase 2:

Digital Evidence Searching and Documentation

Evidence Searching & Doc

- Need to find evidence of events
- Goal: To recognize the digital objects that may contain information about the incident and document them.


Evidence Searching Phase
Phase 1:
Target Definition
Target Object
Phase 2:
Data Extraction and Interpretation
Data Object 1
Data Object 2
Phase 3:
Data Comparison
Target Object
?
==
Data Object x
Phase 4:
Knowledge Update
Evidence Object
Overlaps with
Event Reconstruction

Existing Research (1)

- Target definition
  - Stallard & Levitt - *Automated Analysis for Digital Forensic Science: Semantic Integrity Checking*
  - Carrier & Spafford - *Defining Searches of Digital Crime Scenes*
  - Manually - experience and training
  - Stego & malware signatures
  - Many others….

Existing Research (2)

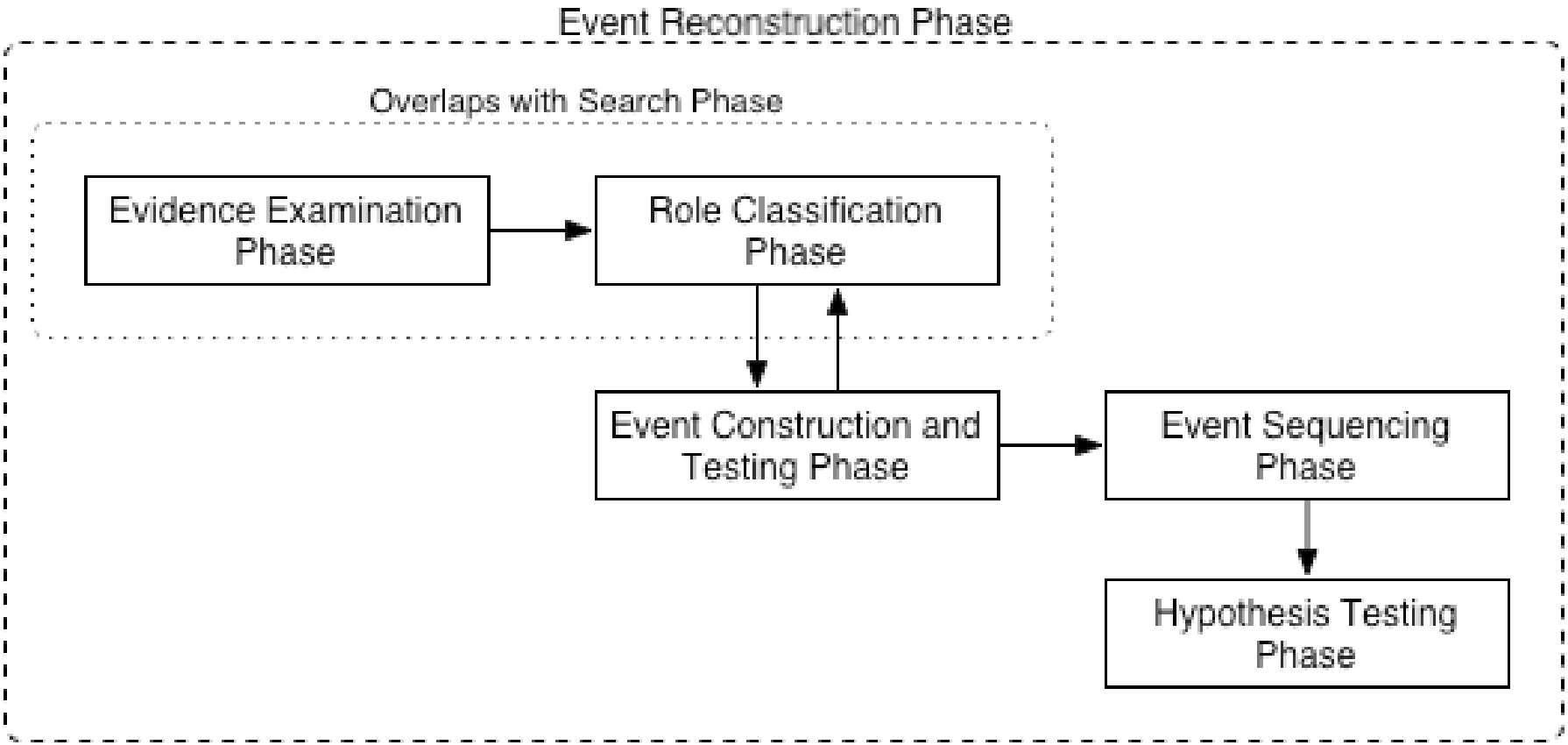
- Extraction
  - All current "forensic" tools
  - Carrier - *Defining Digital Forensic Examination and Analysis Tools*
- Comparison
  - Visual (most tools)
  - Equality (keyword searching)

Phase 3:

Digital Event Reconstruction and Documentation

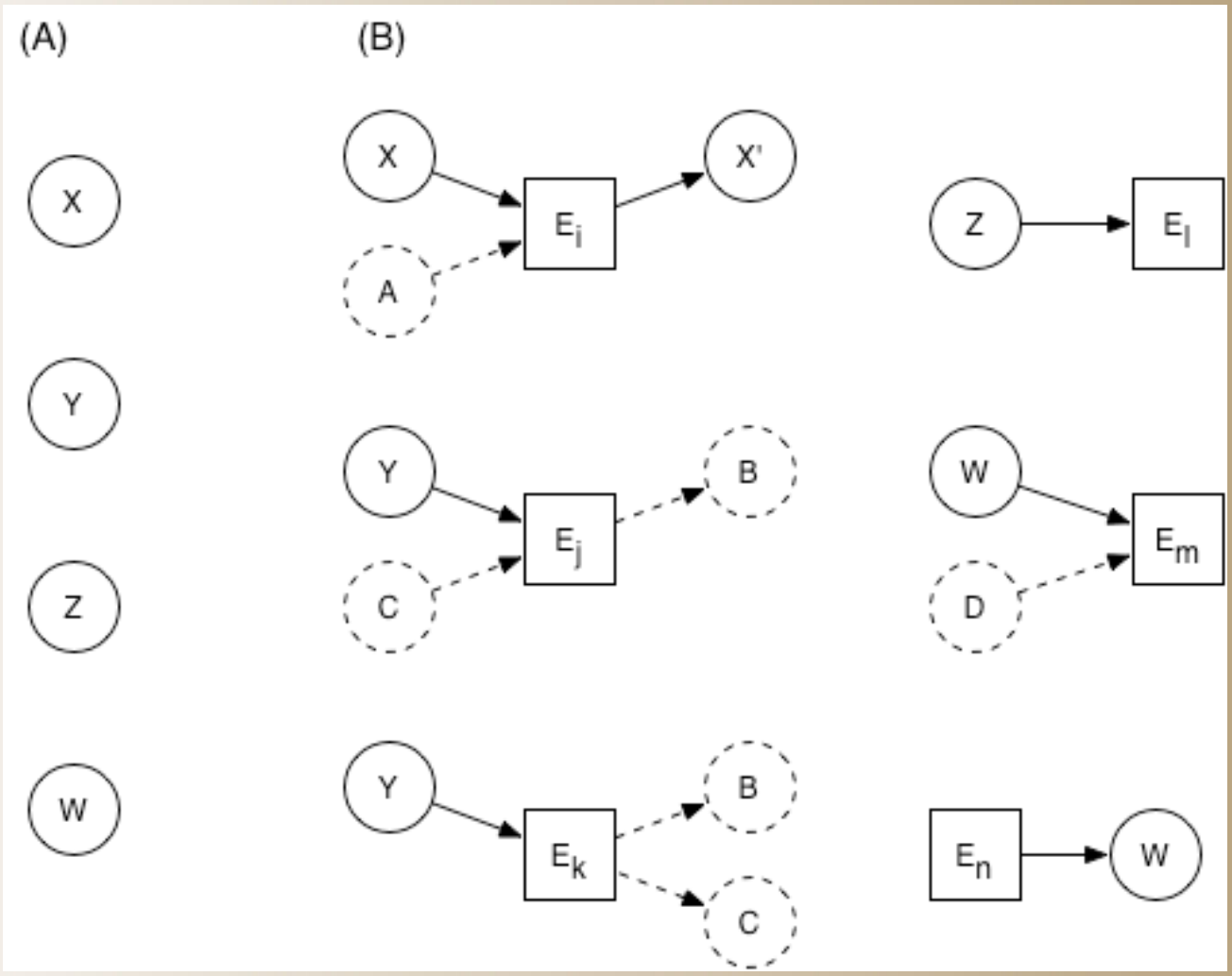
Event Reconstruction

- Need to translate evidence into events
- Goal: To determine and document the events for which evidence exists and has been collected
- Not currently supported by many tools


Event Reconstruction Phase
Overlaps with Search Phase
Evidence Examination Phase
Role Classification Phase
Event Construction and Testing Phase
Event Sequencing Phase
Hypothesis Testing Phase

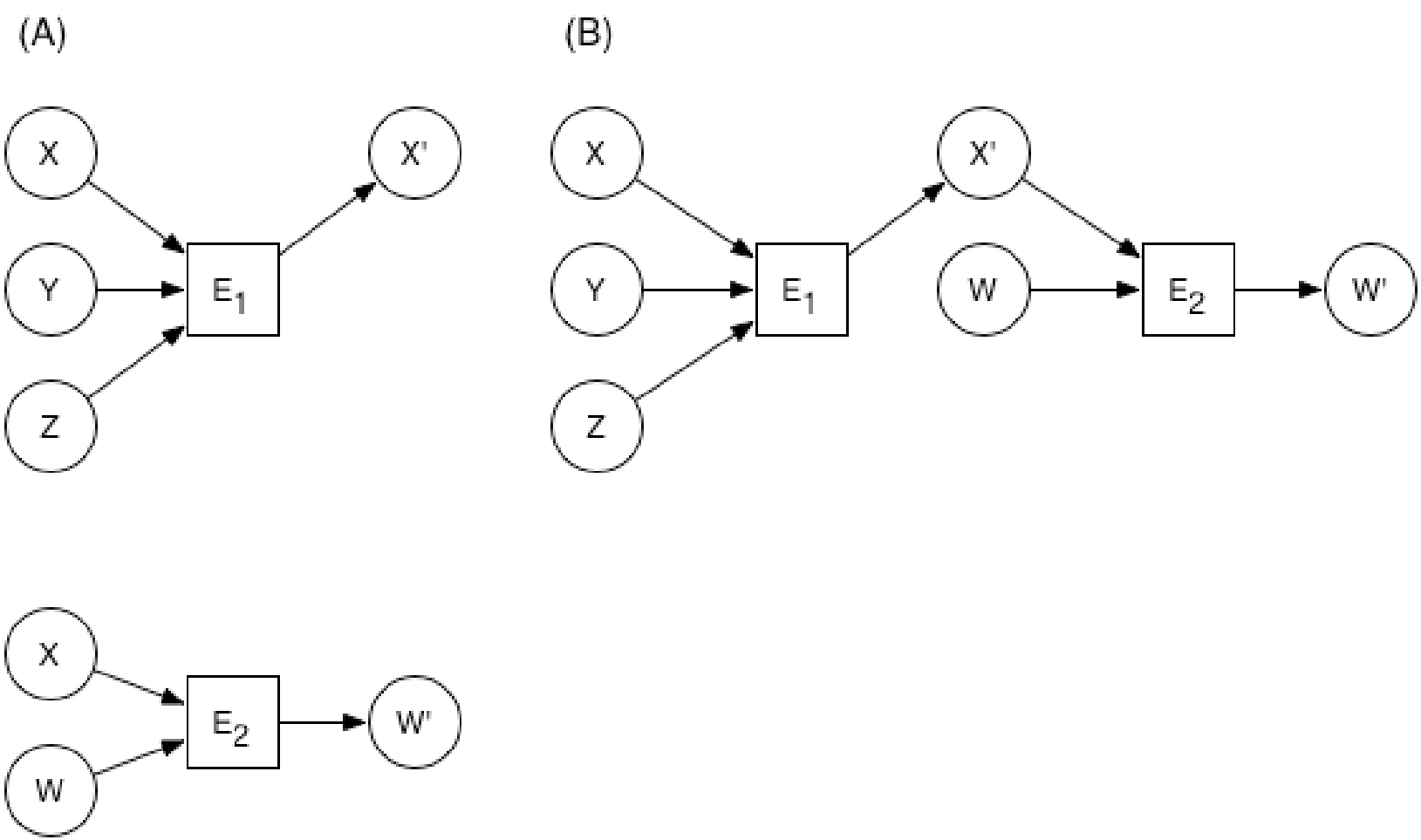
Evidence Examination

Role Classification



Event Construction

Event Sequencing



Existing Research

- Carney & Rogers - *The Trojan Made Me Do It: A First Step in Statistical Based Computer Forensics Event Reconstruction* - IJDE
- Carrier & Spafford - *Defining Digital Crime Scene Event Reconstruction* - JFS
- Gladyshev & Patel - *Finite State Machine Approach to Digital Event Reconstruction* - JDI
- Stephenson - *Modeling of Post-Incident Root Cause Analysis* - IJDE

Conclusion

- High-level phases based on investigation goals:
  - Digital Crime Scene Preservation
  - Digital Evidence Search
  - Digital Event Reconstruction
- Similar to physical crime scene investigation