NETWORK DEFENCE USING ATTACKER-DEFENDER INTERACTION MODELLING

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CSIRT-MU

Research Problem

Automated selection of response actions

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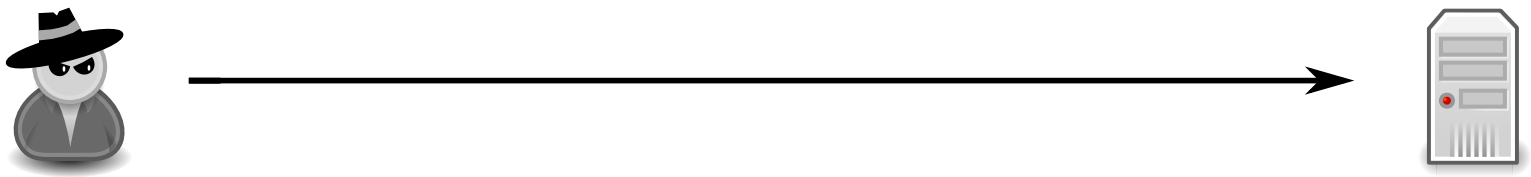
Automated selection of response actions

- The cyber attacks grow both in **number** and **speed**
- Network security still lacks an efficient attack response system capable of running autonomously
- Cyber attack and defence is very complex
  - We are always uncertain about the state of the network
  - We don’t know the attacker’s objectives and previous actions (and whether he is an attacker at all)
  - The number of attack vectors is ever growing

Attack Response



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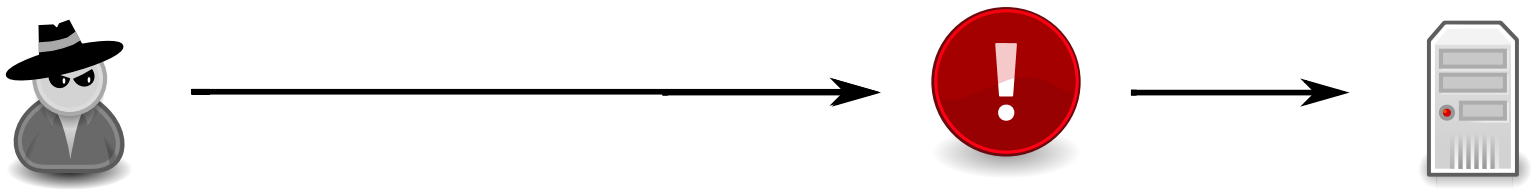
Attack Response



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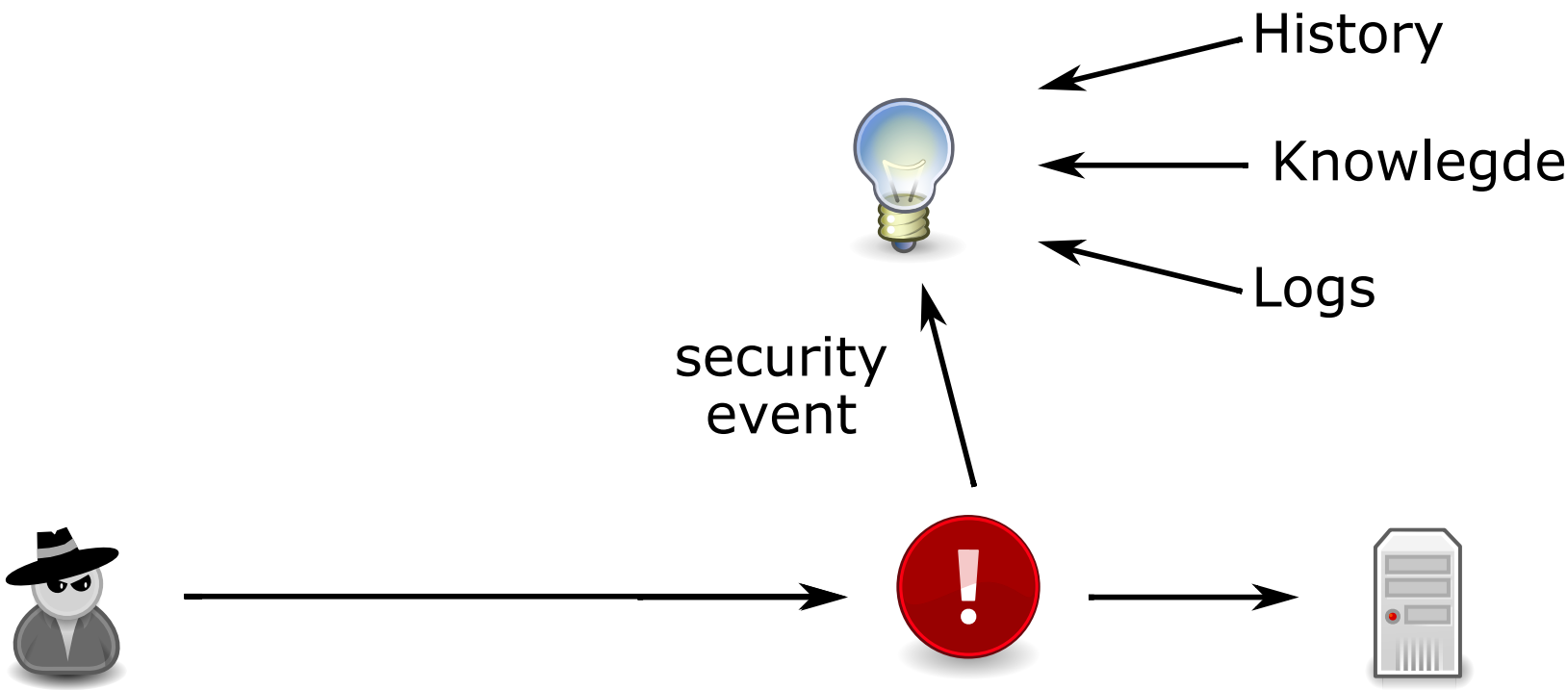

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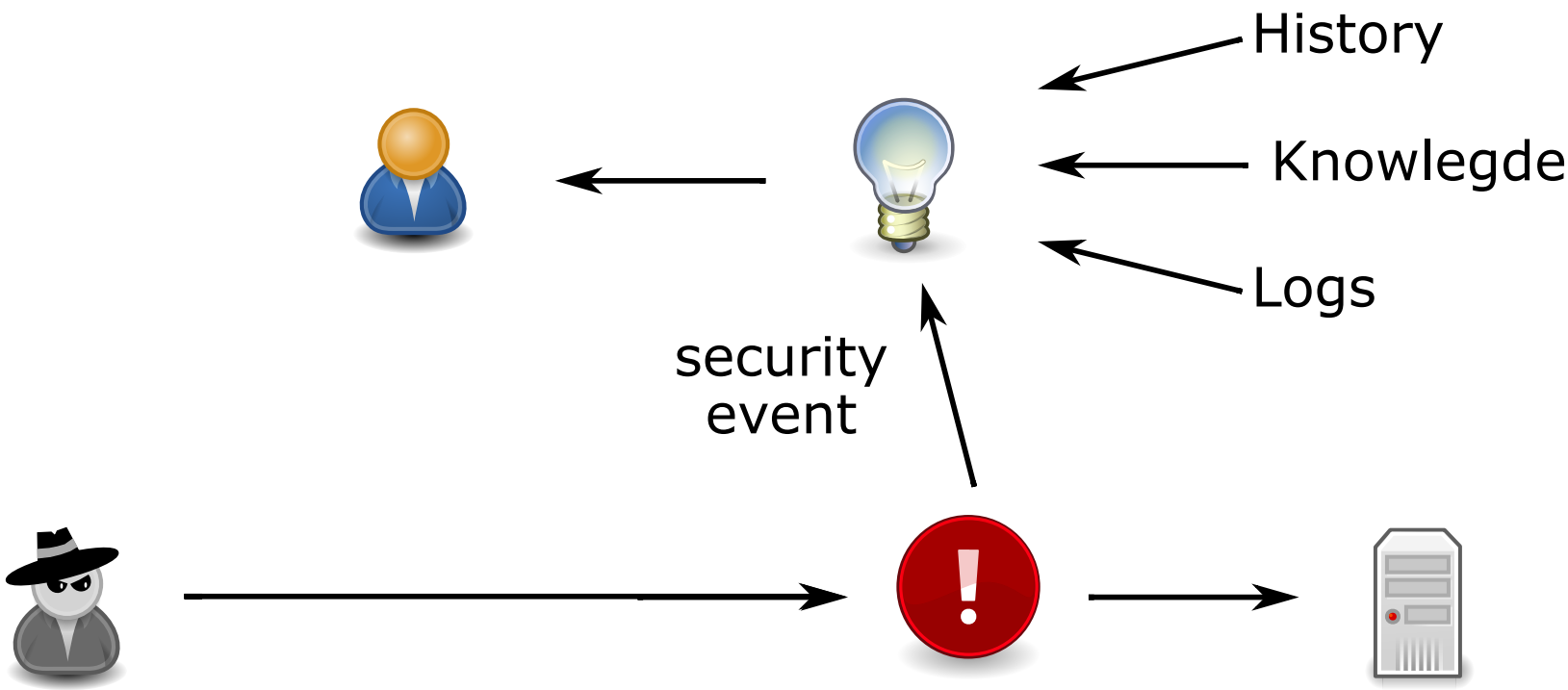

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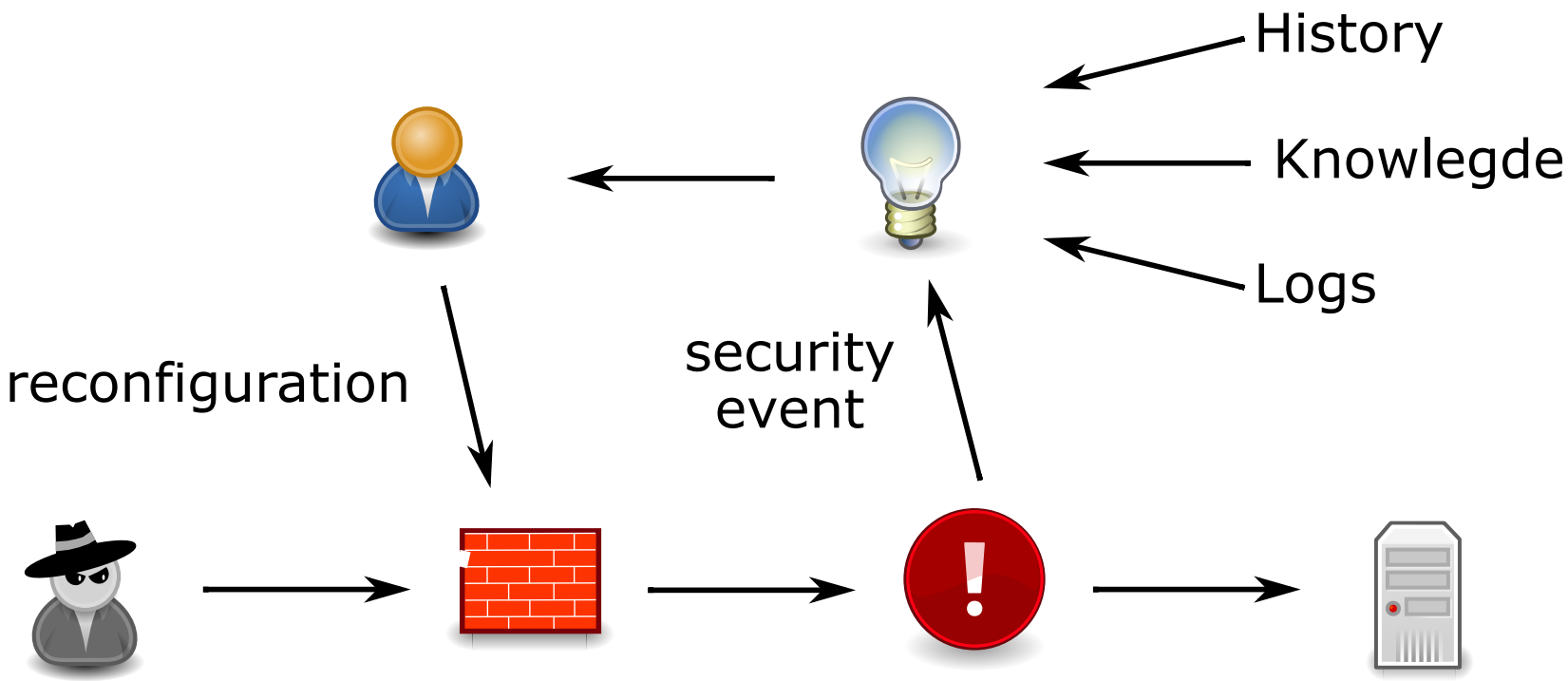

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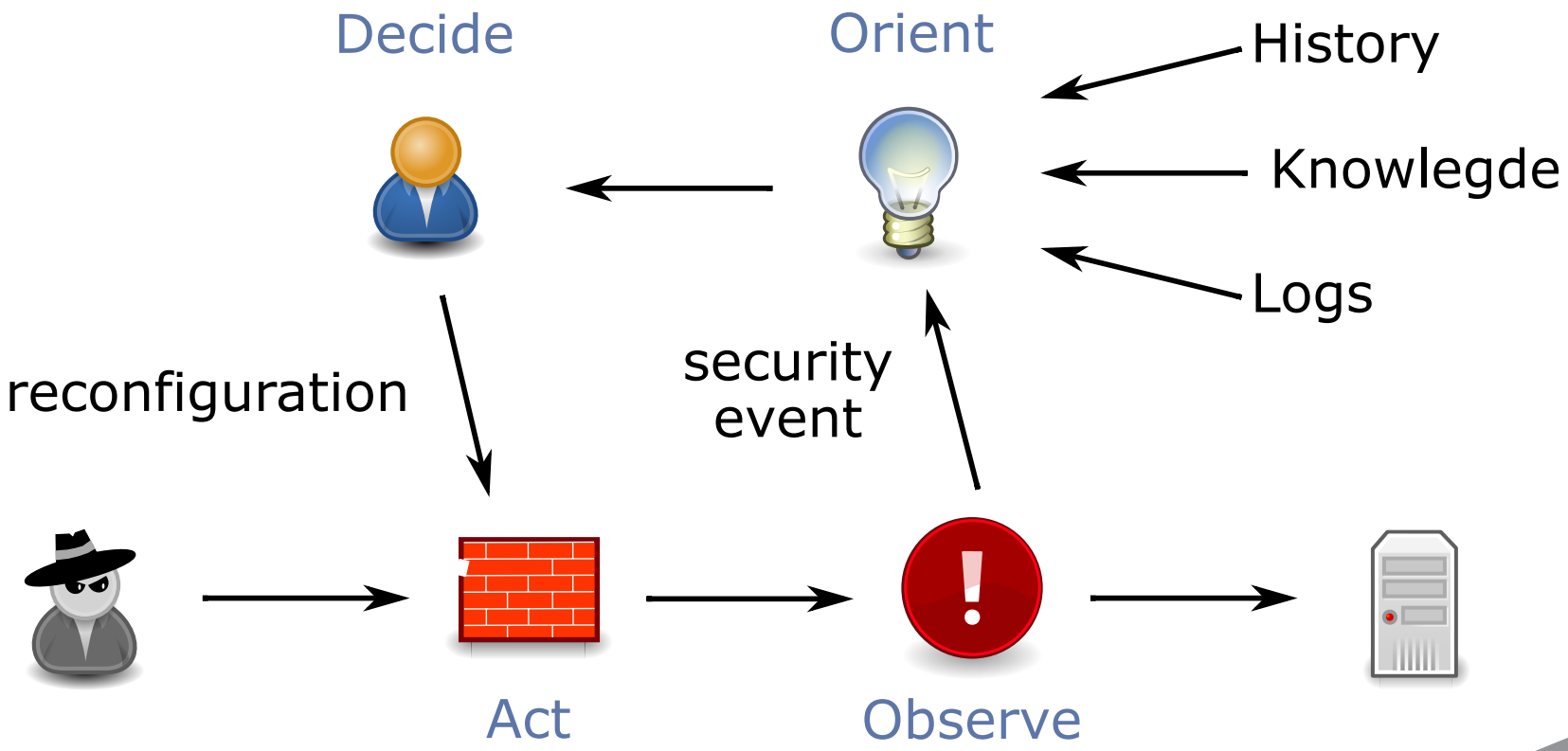

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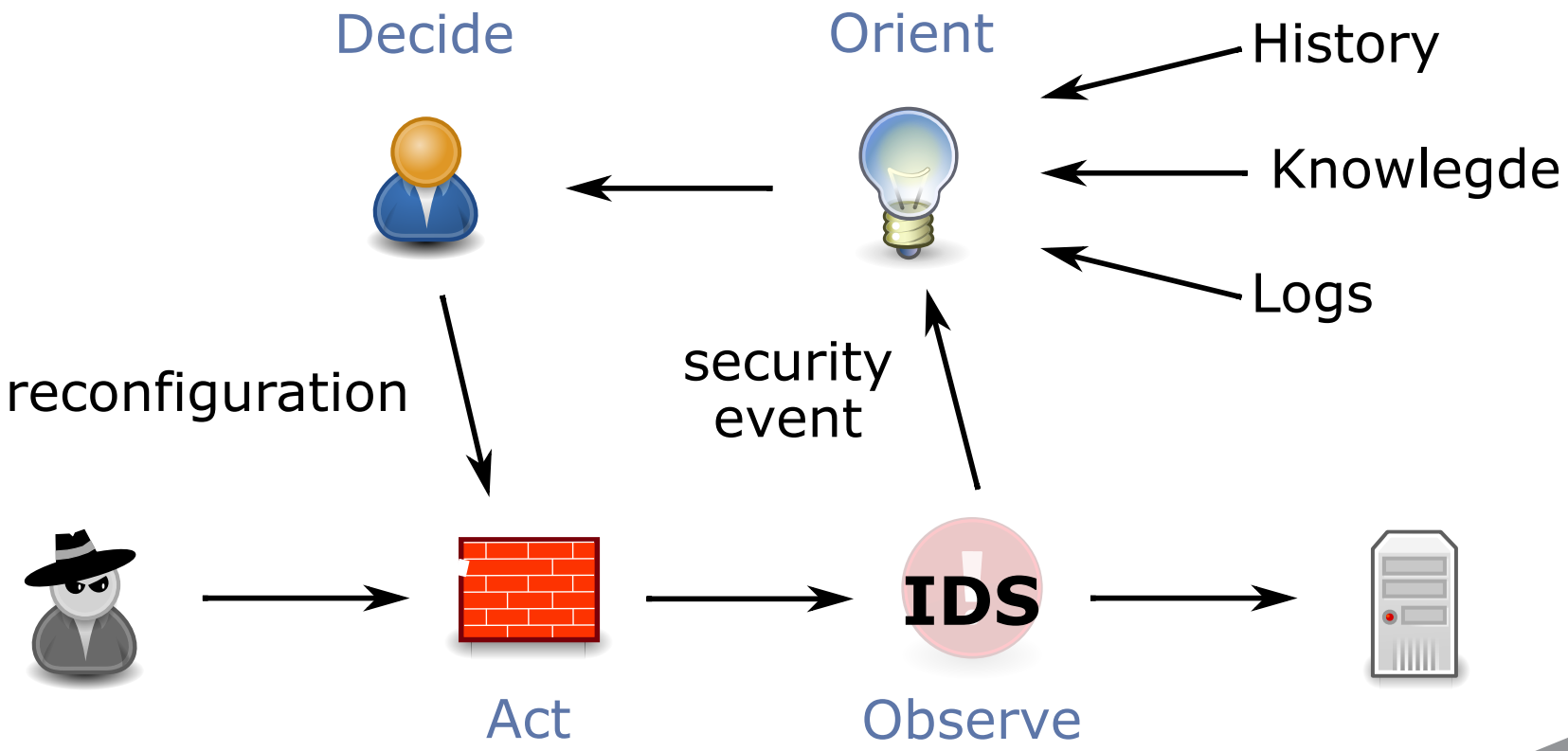

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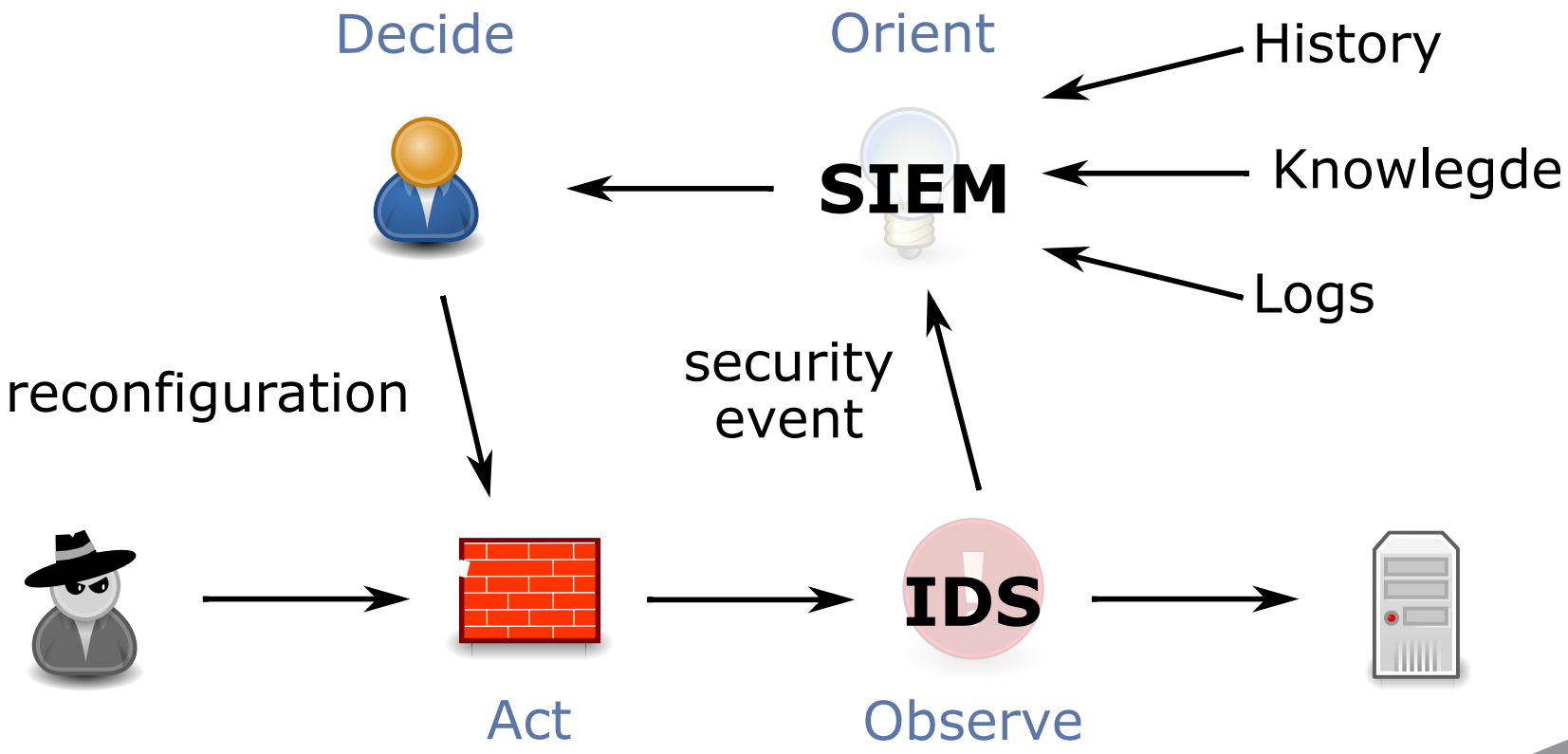

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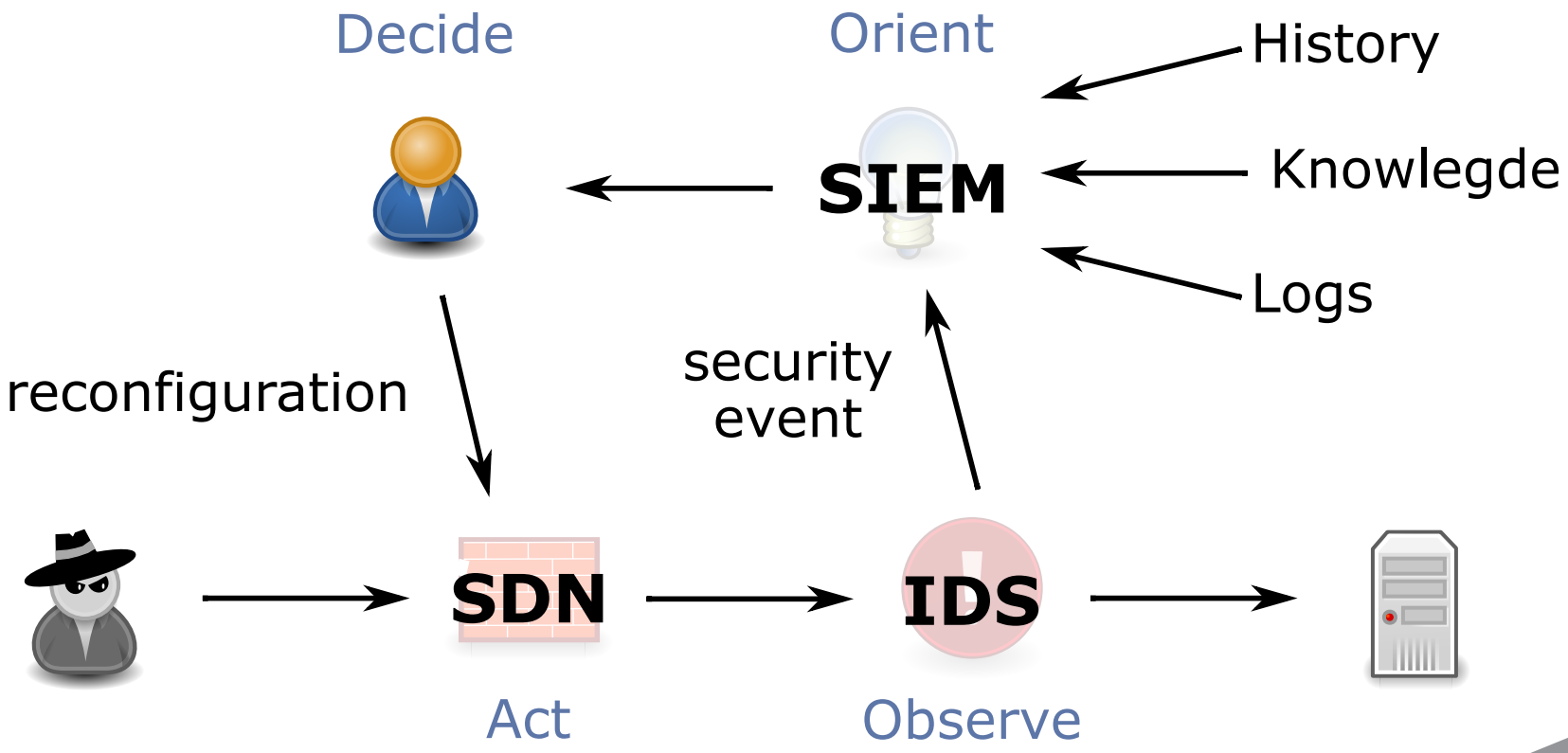

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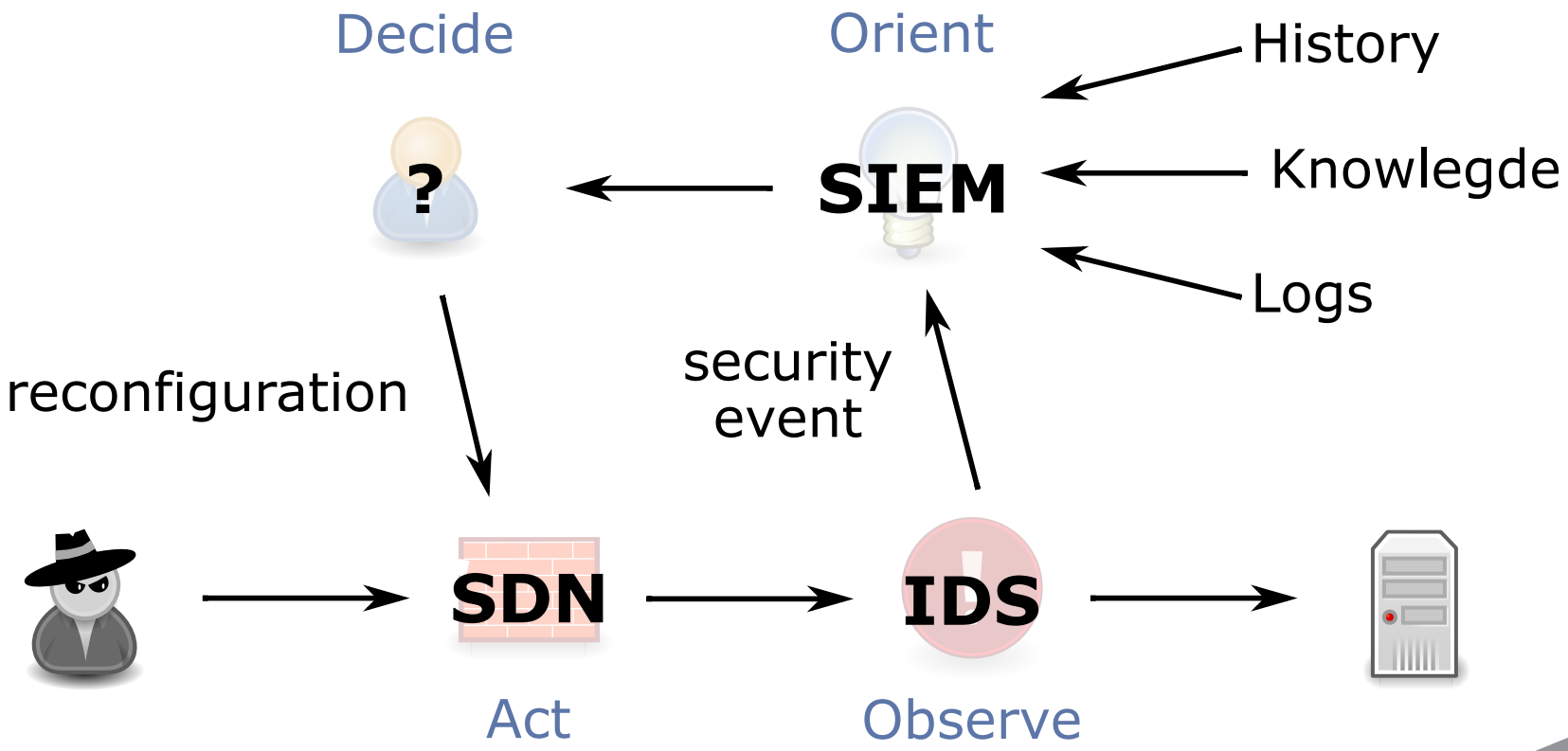

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Research Goal

Utilizing a model of interaction between an attacker and a defender to create more refined network defence strategy

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Utilizing a model of interaction between an attacker and a defender to create more refined network defence strategy

- Select response based on received security events and knowledge of the network
- Include the attacker's motivation in the decision process

Research Topics

Research Question I

How can we model the interaction between an attacker and a defender?

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How can we model the interaction between an attacker and a defender?

Research areas

- Modelling the interaction between an attacker and a defender
  - model the interaction
  - reasonable input parameters
  - optimal actions for defender and attacker
  - computational feasibility for large networks

Research Topics

Research Question II

How can we use the model to form a network defence strategy?

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Research Topics

Research Question II

How can we use the model to form a network defence strategy?

Research areas

- Network defence strategy
  - response action based on observed security alerts
  - unknown state of the network
  - unknown objective and past actions of an attacker

Research Topics

Research Question II

How can we use the model to form a network defence strategy?

Research areas

- Network defence strategy
  - response action based on observed security alerts
  - unknown state of the network
  - unknown objective and past actions of an attacker
- Strategy verification
  - KYPO - cloud-based testbed for simulation of cyber attacks

Research Topics

Research Question III

Can the human instinct and experience be included in the defence strategy?

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Research areas

- How can the response selection benefit from human input
  - **what** in the model or strategy can be made more accurate

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Research Question III

Can the human instinct and experience be included in the defence strategy?

Research areas

- How can the response selection benefit from human input
  - **what** in the model or strategy can be made more accurate
- Merging the human intuition into decision output
  - **how** can we make it more accurate

Proposed Approach

Modelling the interaction between an attacker and a defender

- Game theory toolset
- Use existing or modified model
- Optimal attacker's and defender's strategy

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Estimating model parameters

- Formal network description
  - the topology of the network
  - the hosts and services present in the network
  - the required levels of confidentiality, availability and integrity
  - interdependence of services
- Formal description of attacks and responses

Proposed Approach

Network defence strategy

- Maintain beliefs to manage uncertainty
  - the current state of the network
  - the attacker's past actions
  - the attacker's objective
- Precomputed optimal responses
- Best response action in a given situation

Proposed Approach

Strategy verification

- Cloud-based testbed for simulating cyber attacks
- Computer Security Incident Response Team (CSIRT) training exercises

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Adding human intuition to decision output

- Black-Litterman model in economy
- Formal description of human input
- Updating beliefs based on input

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Summary

- Network security requires an efficient autonomous system which would select a response action based on observed security events

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- Currently automated network defence systems react only in unambiguous situations and the rest of the events must be investigated by security experts

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Summary

- Network security requires an efficient autonomous system which would select a response action based on observed security events
- Currently automated network defence systems react only in unambiguous situations and the rest of the events must be investigated by security experts
- We propose to model the interaction between an attacker and a defender to comprehend how the attacker's goals affect his actions and use the model as a basis for a more refined network defence strategy

THANK YOU FOR YOUR ATTENTION!

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