Human-aware Science of Security

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The Science of Security

- Current state of security research
  1. Find a vulnerability
  2. Fix it!
  3. Introduce a new vulnerability or find another one
  4. Fix it! Go to 3.
- We need to study cyber security as a science
  - It's not just a practice
- We need to model and analyze security systems
  - How secure is a system? Under which conditions?
- Design systems that are resilient to known as well as unknown threats or attacks

The Problem

- According to the IBM security services report (2004), 95% of investigated security incidents involve human error.
- Human users are regarded as the weakest link in the cyber security loop
- “The problem exists between the chair and the keyboard” (PEBCAK)
- We need to design and evaluate security systems with humans in the loop
- An area often understudied in design of security systems

In the Literature

- Two trends in human-aware security: Modeling and Usable security

1. Modeling:
   - Introduce a model of human decision in analogy with the central bank problem in economics [Beautement09]
   - Introduce security ontologies to define information and applications where human factors are vulnerabilities (based on some standards) [Parkin09]
2. Usable security: Design of human-centric security systems
   - Researchers noted usability issues since 1975 (Saltzer and Schroeder: “psychological acceptability”)
   - Most of the work focused on authentication and email encryption

Our Approach

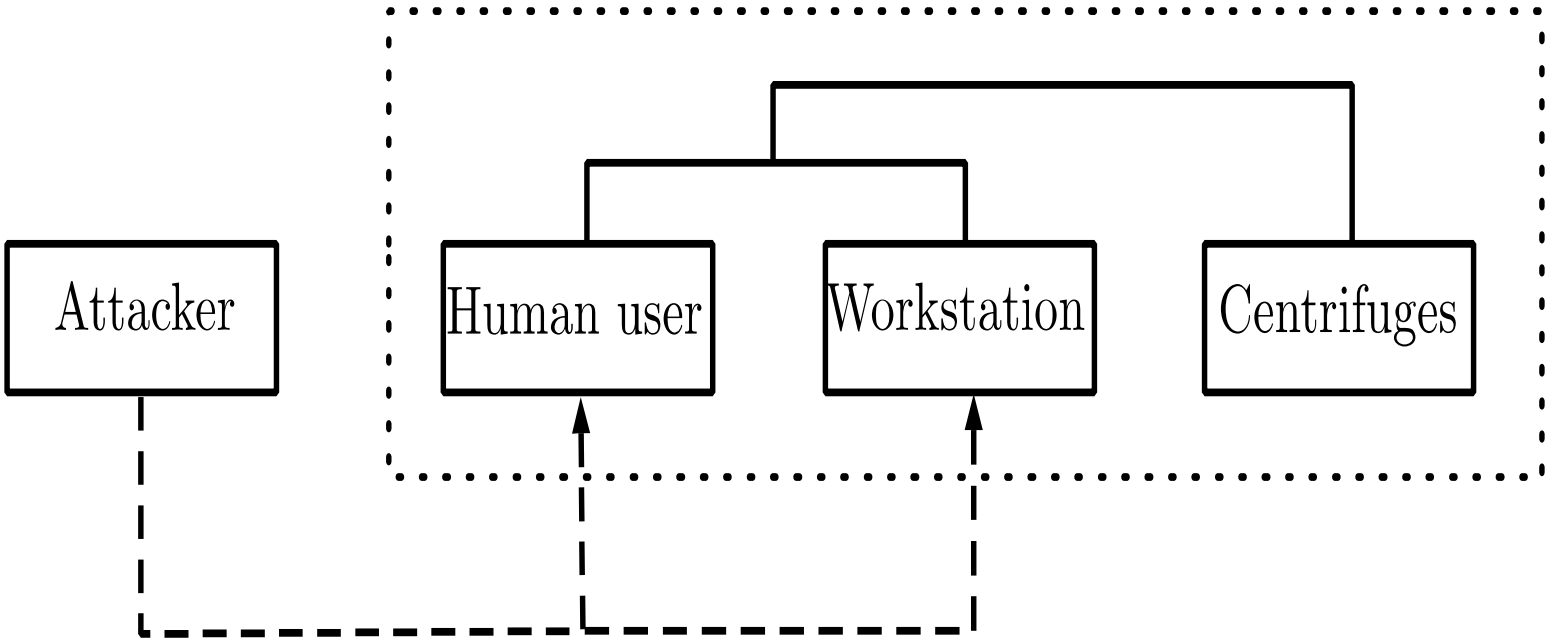
- Include models of human decision making in models of security systems
- Evaluate the security (as well as performance) of systems in light of the uncertainty of human behavior
- Current research: Human Influenced Task Oriented Process (HITOP) formalism
- Goal: Use techniques from human factors, behavioral economics, human computer interaction (HCI), to design accurate models of human behavior

Human Influenced Task Oriented Process (HITOP)

- We defined the HITOP[Eskins11] formalism
  - Model human actions as a set of tasks
  - Assumption: Humans tend to maximize local utilities
  - Define “human decision points” (HDP) where human decisions are important
  - In a HDP, human either willing to perform security action or not
  - Willingness related to local utility function[Eskins11]
- We are looking to evaluate the accuracy of HITOP in modeling human decisions

Case Study

- We will evaluate HITOP through a model of a nuclear power plant, influenced by Stuxnet



Methodology

- Investigate literature in usable security, human factors, human computer interaction, etc.
- Determine the variables that alter human behavior in favor of poor security decisions
- Devise a model that allows us to simulate such decisions
- Design a system model, an attacker model and a human user model
- Use a simulation tool (Mobius) to evaluate the security (performance) of the system in light of all these variables

Relation to SoS

- Understanding and studying security systems is incomplete without considering human factors
- Understanding and modeling human behavior can help in
  - The assessment of the security of implemented systems
  - The design of new systems that are resilient to threats introduce by human elements

References

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