Network Forensics

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Our Research Foci

- Cyber Attacks and Crimes: A painful side-effect of the innovations of Computer and Internet technologies
  - Almost all physical crimes involve digital evidence
  - Low percentage of cases reported to law enforcement
- Our Research Foci in DF and Security:
  - Build Accountability & Incident Response
  - Security Monitoring & Impact Analysis
  - Human-centered Security
- **Recently awarded the first and only NIST CoE in Forensics, 2015-2020.**

NIST Center of Excellence in Forensics- CSAFE

- Motivated by the Innocence Project - http://www.innocenceproject.org/
- 5 year project, led by Prof. Alicia Carriquiry (ISU), with partners: MFRC (Ames Lab), CMU, Virginia, and UC Irvine.
- Core Theme:

> CSAFE aims at advancing the statistical and probabilistic bases of analyses for common forms of pattern and digital evidence, thereby fulfilling the goal of placing forensic science on a firm scientific foundation.

Two focused areas:

- Pattern Evidence
- Digital Evidence

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CSAFE - Broad Center Objectives

- Develop, in collaboration with NIST scientists, new methods for forensic evidence, including objective measures of quality and assessment of sources of variation.
- Develop new inference techniques that account for various sources of uncertainty.
- Establish a sound bases of interpretation for forensic evidence in judicial settings, including test standards and standardized terminology.

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CSAFE – Digital Forensics Objectives

Digital Forensics plays an increasingly significant role in forensic analysis

- Digital world has been the locus of various forms of cybercrime (desktop & laptop computers, cell phones, servers, etc.)
- Almost all physical crimes involve digital evidence (email, logs, etc.)

Key issues:

- Identify the devices used in a crime
- Identify the individual that actually used the device
- Prove a relationship between the individual and evidential data about a criminal activity
- Work with incomplete digital evidence, errors or uncertainty

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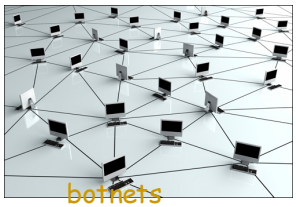
> *"Liberty means responsibility. That is why most men dread it."*
>
> — George Bernard Shaw

http://www.fbi.gov/news/stories/story-index/cyber-crimes

Scareware/malvertising



botnets

Cyber Banking Fraud

Online Child Predators

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A few interesting things

- SODDI

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Who were they?

- SODDI (Some Other Dude Did It)
  - Trojan Defense

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Cyber Crime **A painful side-effect of the innovations of Computer and Internet technologies**

- The possibility of becoming a victim of cyber crime is the number one fear of billions of people
- The findings in annual CSI/FBI Computer Crime and Security Surveys confirm that cyber crime is real and continues to be a significant threat, and cause ruinous financial damage
  - Low percentage of cyber crime cases reported to law enforcement. (In 1996, only 16%; in 2008, 27%)
  - Vast majority of cyber crimes never get caught or prosecuted

Why?

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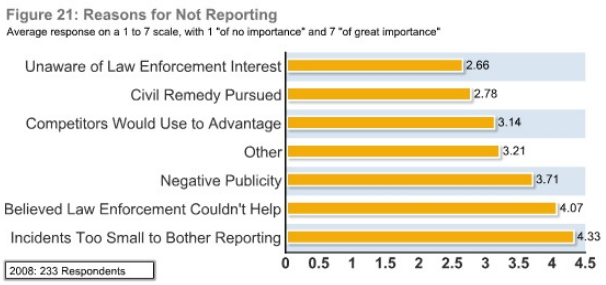
Cyber Crime **A painful side-effect of the innovations of Computer and Internet technologies**

- **Why?**



- Concern of negative publicity
  - Attracting other cyber-attackers
  - Undermining the confidence of their customers, suppliers, and investors
  - Inviting the ridicule of their competitors

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Cyber Crime A painful side-effect of the innovations of Computer and Internet technologies

Cyber criminal activity is growing – not steadily but exponentially, both in frequency and complexity

- Much harder to detect than crimes in the physical world
- Often insiders
- Indirectly through various hiding techniques
  - Botnets
  - Information hiding: steganography, covert channel, etc
  - Anonymity proxies
  - Stepping Stones
  - ……

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Challenges to Digital Forensics

- Increased data size & urgency
  - Data centers, Storage, Time
- Increased use of encryption
  - Child pornography case
- Increased complexity
  - ISP, device diversity
- Anti-Forensics
  - Anonymity
  - Steganography
- "Co-Space"

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Why forensics so challenging

A complex example "Two Player Game - Chess"

Observable with complete and precise info

In cyberspace, do we have an observable "chessboard"?

Two or more player game with

Incomplete and imprecise info

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Outline of This Tutorial

- Overview
- Forensic Q&A
- Case Study
- Traceback
- A Forensic Look of Bitcoin/Cryptocurrency
- Accountability vs Anonymity
- Summary and Future Directions