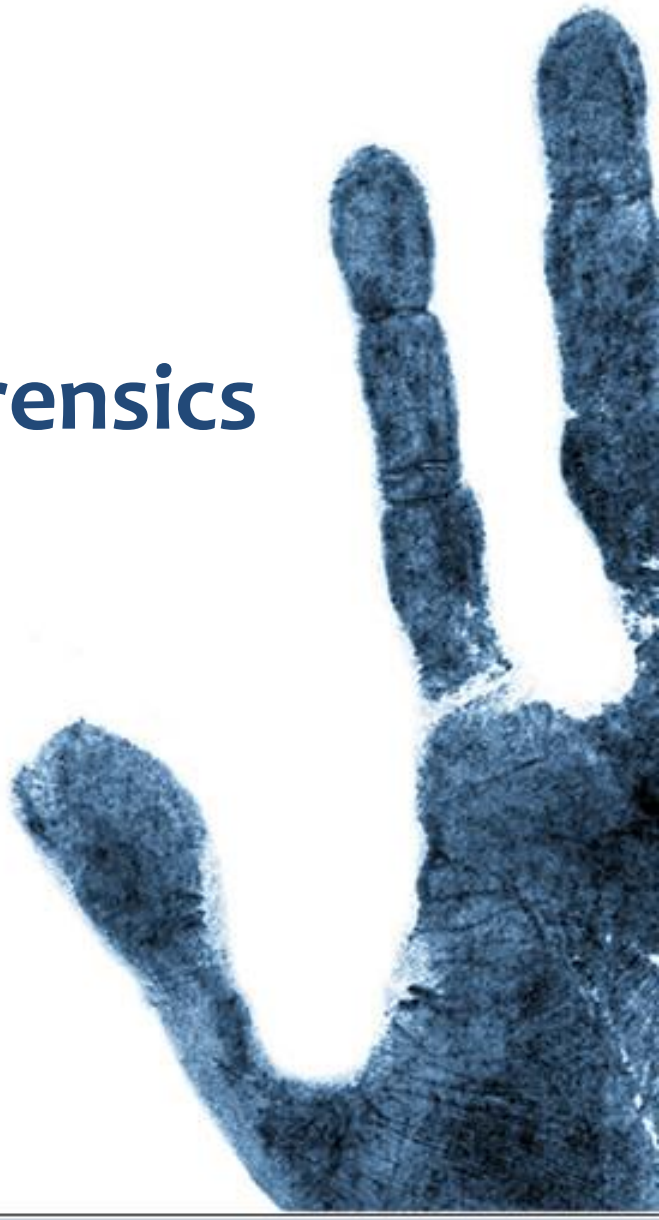
Introduction to Computer Forensics



Introduction

- Topics to be covered
  - Defining Computer Forensics
  - Reasons for gathering evidence
  - Who uses Computer Forensics
  - Steps of Computer Forensics
  - Handling Evidence
  - Investigation initiation / response
  - Handling Information
  - Requirements
  - Anti-Forensics
  - Evidence processing guidelines
  - Methods of hiding Information/data
  - Methods of discovering information/data

Definition

- What is Computer Forensics??
  - Computer forensics involves the **preservation, identification, extraction, documentation, and interpretation** of computer media **for evidentiary and/or root cause analysis.**
  - Evidence might be required for a wide range of computer crimes and misuses
  - Multiple methods of
    - Discovering data on computer system
    - Recovering deleted, encrypted, or damaged file information
    - Monitoring live activity
    - Detecting violations of corporate policy
  - Information collected assists in arrests, prosecution, termination of employment, and preventing future illegal activity

Definition (cont)

- What Constitutes Digital Evidence?
  - Any information being subject to human intervention or not, that can be extracted from a computer.
  - Must be in human-readable format or capable of being interpreted by a person with expertise in the subject.
- Computer Forensics Examples
  - Recovering thousands of deleted emails
  - Performing investigation post employment termination
  - Recovering evidence post formatting hard drive
  - Performing investigation after multiple users had taken over the system

Reasons For Evidence

- Wide range of computer crimes and misuses
  - Non-Business Environment: evidence collected by State and local authorities for crimes relating to:
    - Theft of trade secrets
    - Fraud
    - Extortion
    - Industrial espionage
    - Position of pornography
    - SPAM investigations
    - Virus/Trojan distribution
    - Homicide investigations
    - Intellectual property breaches
    - Unauthorized use of personal information
    - Forgery
    - Perjury
    - etc

Reasons For Evidence (cont)

- Computer related crime and violations include a range of activities including:
  - Business Environment:
    - Theft of or destruction of intellectual property
    - Unauthorized activity
    - Tracking internet browsing habits
    - Reconstructing Events
    - Inferring intentions
    - Selling company bandwidth
    - Wrongful dismissal claims
    - Sexual harassment
    - Software Piracy

Who Uses Computer Forensics?

- Criminal Prosecutors
  - Rely on evidence obtained from a computer to prosecute suspects and use as evidence
- Civil Litigations
  - Personal and business data discovered on a computer can be used in fraud, divorce, harassment, or discrimination cases
- Insurance Companies
  - Evidence discovered on computer can be used to mollify costs (fraud, worker's compensation, arson, etc)
- Private Corporations
  - Obtained evidence from employee computers can be used as evidence in harassment, fraud, and embezzlement cases

Who Uses Computer Forensics? (cont)

- Law Enforcement Officials
  - Rely on computer forensics to backup search warrants and post-seizure handling
- Individual/Private Citizens
  - Obtain the services of professional computer forensic specialists to support claims of harassment, abuse, or wrongful termination from employment

Steps of Computer Forensics

- According to many professionals, Computer Forensics is a four (4) step process
  - Acquisition
    - Physically or remotely obtaining possession of the computer, all network mappings from the system, and external physical storage devices
  - Identification
    - This step involves identifying what data could be recovered and electronically retrieving it by running various Computer Forensic tools and software suites
  - Evaluation
    - Evaluating the information/data recovered to determine if and how it could be used again the suspect for employment termination or prosecution in court

Steps Of Computer Forensics (cont)

- Presentation
  - This step involves the presentation of evidence discovered in a manner which is understood by lawyers, non-technically staff/management, and suitable as evidence as determined by United States and internal laws

Sources of Digital Evidence

- Digital evidence can be collected from many sources: computers, cell phones, digital cameras, hard drives, USB memory devices etc.
- Others are: settings of digital thermometers, black boxes inside vehicles, and web pages

Sources of Digital Evidence

- Special care must be taken when handling computer evidence: most digital information is easily changed, and once changed it is usually impossible to detect that a change has taken place (or to revert the data back to its original state) unless other measures have been taken.

Handling Evidence

- Admissibility of Evidence
  - Legal rules which determine whether potential evidence can be considered by a court
  - Must be obtained in a manner which ensures the authenticity and validity and that no tampering had taken place
- No possible evidence is damaged, destroyed, or otherwise compromised by the procedures used to search the computer
- Preventing viruses from being introduced to a computer during the analysis process
- Extracted / relevant evidence is properly handled and protected from later mechanical or electromagnetic damage.

Handling Evidence (cont)

- Establishing and maintaining a continuing chain of custody
- Limiting the amount of time business operations are affected
- Not divulging and respecting any ethically [and legally] client-attorney information that is inadvertently acquired during a forensic exploration

Imaging electronic media

- The process of creating an exact duplicate of the original evidentiary media is often called Imaging. Using hard-drive duplicator or software imaging tools such as DriveImage XML, Mondo Rescue or Clonezilla, the entire hard drive is completely duplicated/cloned.
- The original drive is then moved to secure storage to prevent tampering.

Collecting Volatile Data

- If the machine is still active, any intelligence which can be gained by examining the applications currently open is recorded. If the machine is suspected of being used for illegal communications, such as terrorist traffic, not all of this information may be stored on the hard drive. There is need to collect volatile data from the computer at the onset of the response.
- Several Open Source tools are available to conduct an analysis of open ports, mapped drives (including through an active VPN connection), and open or mounted encrypted files (containers) on the live computer system. Utilizing open source tools and commercially available products, it is possible to obtain an image of these mapped drives and the open encrypted containers in an unencrypted format.

Evaluation/Analysis

- All digital evidence must be analyzed to determine the type of information that is stored upon it. For this purpose, specialty tools are used that can display information in a format useful to investigators.
- Typical forensic analysis includes a manual review of material on the media, reviewing the Windows registry for suspect information, discovering and cracking passwords, keyword searches for topics related to the crime, and extracting e-mail and images for review.

Reporting/Presentation

- Once the analysis is complete, a report is generated.
- This report may be a written report, oral testimony, or some combination of the two

Initiating An Investigation

- DO NOT begin by exploring files on system randomly
- Establish evidence custodian - start a detailed journal with the date and time and date/information discovered
- If possible, designate suspected equipment as “off-limits” to normal activity. This includes back-ups, remotely or locally scheduled house-keeping, and configuration changes
- Collect email, DNS, and other network service logs

Initiating An Investigation (cont)

- Capture exhaustive external TCP and UDP port scans of the host
  - Could present a problem if TCP is wrapped
- Contact security personnel, management, state and local enforcement, as well as affected sites or persons

Incidence Response

- Identify, designate, or become evidence custodian
- Review any existing journal of what has been done to system already and/or how intrusion was detected
- Begin new or maintain existing journal
- Install monitoring tools (sniffers, port detectors, etc.)
- Without rebooting or affecting running processes, perform a copy of physical disk
- Capture network information
- Capture processes and files in use (e.g. dll, exe)
- Capture config information
- Receipt and signing of data

Handling Information

- Information and data being sought after and collected in the investigation must be properly handled
- Volatile Information
  - Network Information
    - Communication between system and the network
  - Active Processes
    - Programs and daemons currently active on the system
  - Logged-on Users
    - Users/employees currently using system
  - Open Files
    - Libraries in use; hidden files; Trojans (rootkit) loaded in system

Handling Information (cont)

- Non-Volatile Information
  - This includes information, configuration settings, system files and registry settings that are available after reboot
  - Accessed through drive mappings from system
  - This information should investigated and reviewed from a backup copy

Computer Forensic Requirements

- Hardware
  - Familiarity with all internal and external devices/components of a computer
  - Thorough understanding of hard drives and settings
  - Understanding motherboards and the various chipsets used
  - Power connections
  - Memory

- BIOS
  - Understanding how the BIOS works
  - Familiarity with the various settings and limitations of the BIOS

Computer Forensic Requirements (cont)

- Familiar with all Operation Systems
- Software
  - Familiarity with most popular software packages such as Office
- Forensic Tools
  - Familiarity with computer forensic techniques and the software packages that could be used

Anti-Forensics

- Software that limits and/or corrupts evidence that could be collected by an investigator
- Performs data hiding and distortion
- Exploits limitations of known and used forensic tools
- Works both on Windows and LINUX based systems
- In place prior to or post system acquisition

Evidence Processing Guidelines

- New Technologies Inc. recommends following 16 steps in processing evidence
- They offer training on properly handling each step

Step 1: Shut down the computer

- Considerations must be given to volatile information
- Prevents remote access to machine and destruction of evidence (manual or ant-forensic software)

Step 2: Document the Hardware Configuration of The System

- Note everything about the computer configuration prior to re-locating

Evidence Processing Guidelines (cont)

Step 3: Transport the Computer System to A Secure Location

- Do not leave the computer unattended unless it is locked in a secure location

Step 4: Make Bit Stream Backups of Hard Disks and any storage available

Step 5: Mathematically Authenticate Data on All Storage Devices

- Must be able to prove that you did not alter any of the evidence after the computer came into your possession

Step 6: Document the System Date and Time

Step 7: Make a List of Key Search Words

Step 8: Evaluate the Windows Swap File

Evidence Processing Guidelines (cont)

Step 9: Evaluate File Slack

- File slack is a data storage area of which most computer users are unaware; a source of significant security leakage.

Step 10: Evaluate Unallocated Space (Erased Files)

Step 11: Search Files, File Slack and Unallocated Space for Key Words

Step 12: Document File Names, Dates and Times

Step 13: Identify File, Program and Storage Anomalies

Step 14: Evaluate Program Functionality

Step 15: Document Your Findings

Step 16: Retain Copies of Software Used

For Digital Forensic Analysis Methodology, see https://www.crime-scene-investigator.net/computer-forensics-digital-forensic-analysis-methodology.html

Methods Of Hiding Data

- To human eyes, data usually contains known forms, like images, e-mail, sounds, and text. Most Internet data naturally includes gratuitous headers, too. These are media exploited using new controversial logical encodings: steganography and marking.
- **Steganography**: The art of storing information in such a way that the existence of the information is hidden.

Methods Of Hiding Data (cont)

- **T**o **h**uman **e**yes, **d**ata **u**sually **c**ontains **k**nown **f**orms, **l**ike **i**mages, **e**-mail, **s**ounds, **a**nd **t**ext. **M**ost **I**nternet **d**ata **n**aturally **i**ncludes **g**ratuitous **h**eaders, **t**oo**.** **T**hese **a**re **m**edia **e**xploited **u**sing **n**ew **c**ontroversial **l**ogical **e**ncodings: **s**teganography **a**nd **m**arking.

- ***The duck flies at midnight. Tame uncle Sam***
  - Simple but effective when done well

For an impressive understanding kindly see,
https://www.youtube.com/watch?v=TWEXCYQKyDc

Methods Of Hiding Data (cont)

- **Watermarking**: Hiding data within data
  - Information can be hidden in almost any file format.
  - File formats with more room for compression are best
    - Image files (JPEG, GIF)
    - Sound files (MP3, WAV)
    - Video files (MPG, AVI)
  - The hidden information *may* be encrypted, but not necessarily
  - Numerous software applications will do this for you: Many are freely available online

Methods Of Hiding Data (cont)

- **Other Methods**
  - **Manipulating HTTP requests** by changing (unconstrained) order of elements
    - The order of elements can be preset as a 1 or 0 bit
    - No public software is available for use yet, but the government uses this method for its agents who wish to transfer sensitive information online
    - Undetectable because there is no standard for the order of elements and it is, in essence, just normal web browsing
  - **Encryption:** The problem with this is that existence of data is not hidden, instead it draws attention to itself.
    - With strong enough encryption, it doesn't matter if its existence is known

Methods Of Detecting/Recovering Data

- **Steganalysis -** the art of detecting and decoding hidden data
  - Hiding information within electronic media requires alterations of the media properties that may introduce some form of degradation or unusual characteristics
  - The pattern of degradation or the unusual characteristic of a specific type of steganography method is called a **signature**
  - Steganalysis software can be trained to look for a signature

Methods Of Detecting/Recovering Data (cont)

- **Steganalysis Methods - Detection**
  - **Human Observation**
    - Opening a text document in a common word processor may show appended spaces and "invisible" characters
    - Images and sound/video clips can be viewed or listened to and distortions may be found
      - Generally, this only occurs if the amount of data hidden inside the media is too large to be successfully hidden within the media (15% rule)
  - **Software analysis**
    - Even small amounts of processing can filter out echoes and shadow noise within an audio file to search for hidden information
    - If the original media file is available, hash values can easily detect modifications

Methods Of Detecting/Recovering Data (cont)

- **Steganalysis Methods – Recovery**
  - Recovery of watermarked data is extremely hard
    - Currently, there are very few methods to recover hidden, encrypted data.
  - Data hidden on disk is much easier to find. Once found, if unencrypted, it is already recovered
  - Deleted data can be reconstructed (even on hard drives that have been magnetically wiped)
  - Check swap files for passwords and encryption keys which are stored in the clear (unencrypted)
  - **Software Tools**
    - Scan for and reconstruct deleted data
    - Break encryption
    - Destroy hidden information (overwrite)

Department of Defense Digital Forensic

https://www.youtube.com/watch?v=CWtTq8PoPO4