Digital forensics

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Digital forensics

- lectures: dr. Andrej Brodnik
- lab sessions: dr. Gašper Fele-Žorž
- e-sources: učilnica

Course description

- Literature:
  - ***Eoghan Casey: Digital Evidence and Computer Crime (third edition)***
  - DFRWS (Digital Forensics Research Conference): http://www.dfrws.org/
  - Digital Investigation – Elsevier: http://www.journals.elsevier.com/digital-investigation/
  - SSDDFJ (Small Scale Digital Device Forensics Journal): http://www.ssddfj.org/
  - IFIP Working Group 11.9 Digital Forensics: http://www.ifip119.org/
  - IJDCF (International Journal of Digital Crime and Forensics): http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=1112

Course description – cont.

- lectures: including at least two invited lectures
- homework (HW):
  - four homework assignments from lectures (!), exercises and books
  - *for a positive grade: each homework is at least 20% and an average of at least 40%*
- lab work (LW):
  - two practical laboratory tasks
  - tasks placed in učilnica, where the results are also submitted
  - *for a positive grade: each task at least 20% and an average of at least 50%*

Course description – cont.

- seminar (SN):
  - a group will have to read: a scientific article from a magazine or conference, books, tools, or alike
  - presentation (20 minutes) and a written product, which is reviewed by colleagues and ultimately a final product
  - timetable:
    - by 4.3. group selection; by 11.3. each group issues a proposal for the topic of its seminar paper, which is confirmed or rejected, but no later than 18. 3. confirmed;
    - by 27.5. submitted presentation; by 13.5. submitted seminar; by 27.5. review; by 10.6. final text;
    - presentation of seminar papers in May and June
  - *for a positive grade: all assignments submitted and at least 40% from the presentation and 40% from the final written product and at least 50% from the overall grade of the seminar paper*

Course description – cont.

- written exam (WE):
  - only one written exam mid-year (scheduled for week 7. 5.)
  - *for a positive grade: at least 50%*

- final grade:

1/3 * WE + 1/3 * SN + 1/3 * (½ * LW + ½ * HW)

Course content

- Introduction and basics
- Investigation of an electronic device with an introduction to criminal proceedings
- Computers – hardware
- Operating Systems (MS Windows, Unix/Linux)
- Computer networks
- Mobile devices
- Performing a digital investigation
- Digital forensics of images

images in slides are from the book © 2011: ***Eoghan Casey: Digital Evidence and Computer Crime (third edition)***

Course content – cont.

- invited lectures:
  - Digital forensics at the Police
  - Protection of personal data (Information Commissioner)
  - Digital forensics of networks (SI-CERT)

Introduction and basics

chapters 1 – 5

The basics of digital forensics

chapter 1

- What is digital evidence?
  - Digital evidence is any digital information that is stored or transferred which enables confirmation or denial of a [criminal] act.
- What is a computer system?
  - open computer systems
  - communication systems
  - embedded systems

The basics of digital forensics

- to carry out a forensic investigation, knowledge is not enough, as it requires certification of personnel, organization, laboratory, …

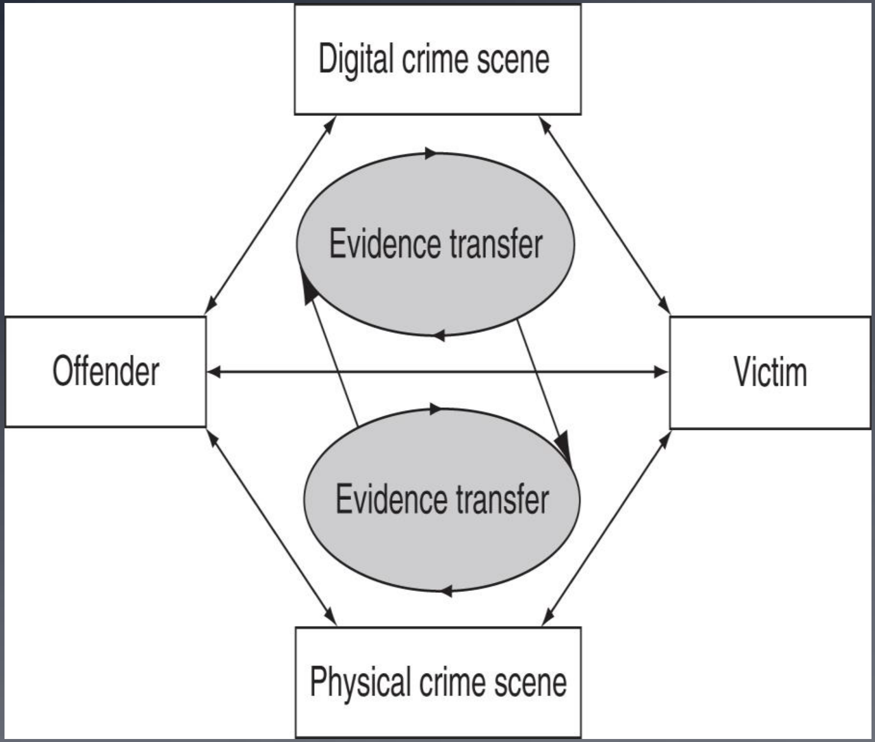
Principles of digital forensics

- use of science for the needs of law
- the importance of distinguishing between certainty and probability :

The lack of evidence is not evidence of non-existence!

- preparation and storage of material for potential litigation

Exchanging evidence



- fingerprints (on the keyboard)
- e-mail and notes
- notes about visited sites
- communication trails
- ...

Exchanging evidence between the victim and the perpetrator (or scene)

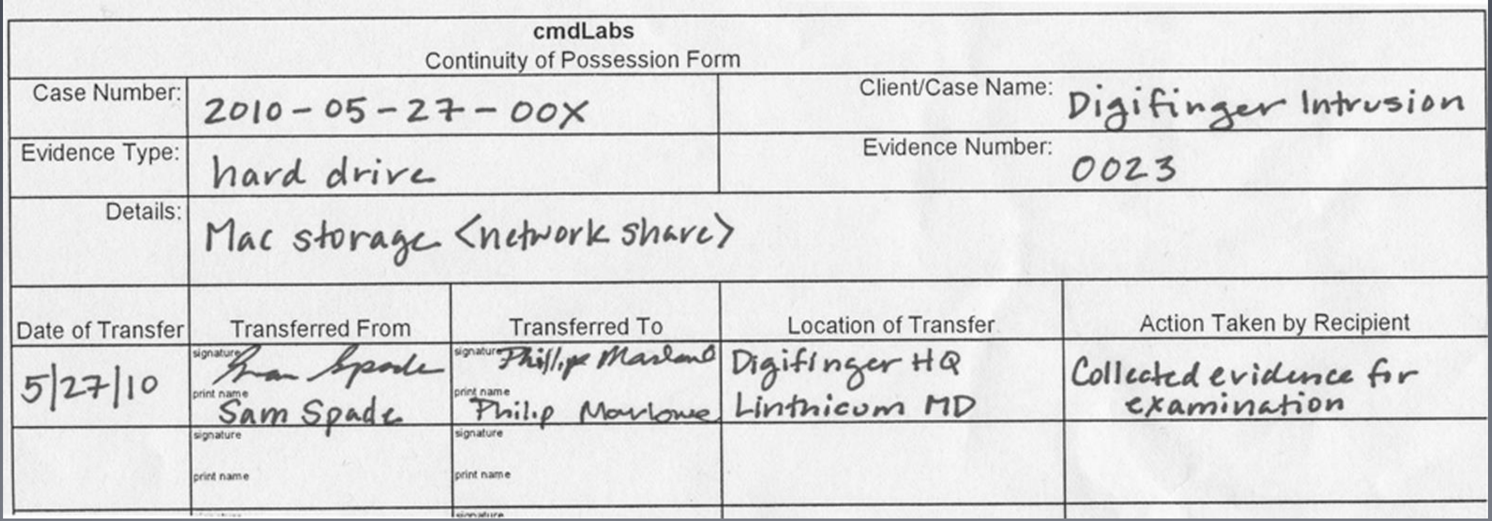
Locard's principle of exchange

Evidence

- evidence has common properties (all programs of this type) and special properties (concrete settings)
- digital evidence acceptable in court:
  - must be properly processed (captured) and
  - must be stored in a forensically correct manner
- that‘s why all actions on the scene must be recorded

Evidence

- ensuring authenticity:
  1. the content must be unchanged
  2. content must originate from the scene (recording the order of possession of evidence - the evidence chain)
  3. additional information on the handling of evidence



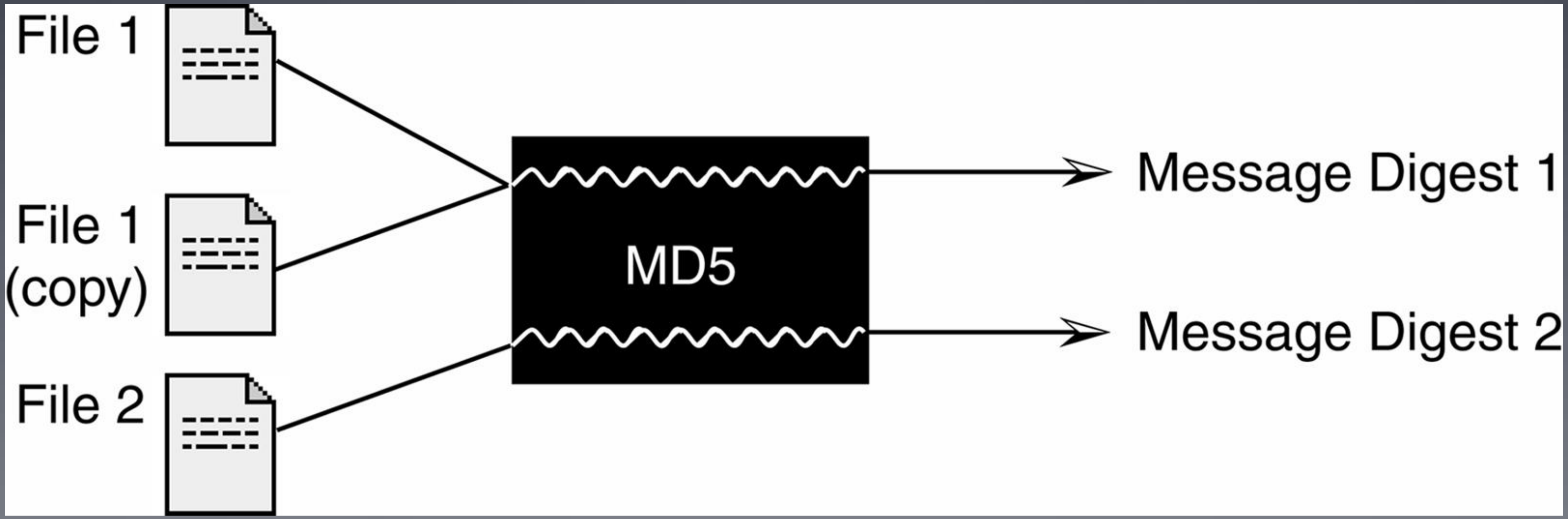
cmdLabs
Continuity of Possession Form

Case Number:	2010-05-27-00X	Client/Case Name:	Digifinger Intrusion
Evidence Type:	hard drive	Evidence Number:	0023
Details:	Mac storage <network share>		

Date of Transfer	Transferred From	Transferred To	Location of Transfer	Action Taken by Recipient
5/27/10	signature Sam Spade print name Sam Spade	signature Phillip Marlowe print name Philip Marlowe	Digifinger HQ Linthicum MD	Collected evidence for examination
	signature print name	signature print name		
		signature		

The integrity of the evidence

- the accepted form of ensuring the integrity of evidence is signing it with a spray function
  - MD5, SHA-1, …



Handling evidence

- objectivity of evidence
  - contains interpretation and presentation of evidence
- repeatability of evidence analysis

The challenges of handling digital evidence

- residue or reconstruction is not the same as the whole material:
  - the reconstructed file that was deleted is not the same as the partitions of it
  - the remnants of the sent e-mail are not the same as the entire e-mail
- the connection between (digital) evidence and the perpetrator is not always obvious
- data is not eternal
  - traffic information on the network

The challenges of handling digital evidence

- evidence is not necessarily error-free
  - the administrator has already tried to save the deleted file
  - the system administrator changed the content to secure the system
  - there was an error during data capture (non-standard procedure)
  - during the data capture, an infected medium was used
  - the media with the stored data has been damaged
  - ...

The digital world is not separate from the real one

- example: a buyer bought a good through eBay
  - *case example: Auction Fraud, 2000*; str. 29
- data can come from unexpected places

Developing the language of computer crime research

chapter 2

- there were no computers at the beginning, and the law only protected material evidence
- digital evidence includes:
  - computer (file) forensics
  - network forensics
  - mobile forensics
  - malware forensics
- important difference between research and data analysis
  - the investigation includes capture, organization, …
  - the analysis represents the actual processing of evidence

The role of computer

According to Parker:

1. as the object of a crime
   - when a computer is stolen or destroyed
2. as the subject of a crime - a computer is the environment in which the crime is committed
   - when a computer is infected by a virus or impaired in some other way to inconvenience the individuals who use it
3. as the tool for conducting or planning a crime
   - when a computer is used to forge documents or break into other computers
4. the symbol of the computer itself to intimidate or deceive
   - offering services or the capabilities of computer services: gains on the stock exchange, ...

- data source(!!) - remains of files, e-mails, ...

The role of computer

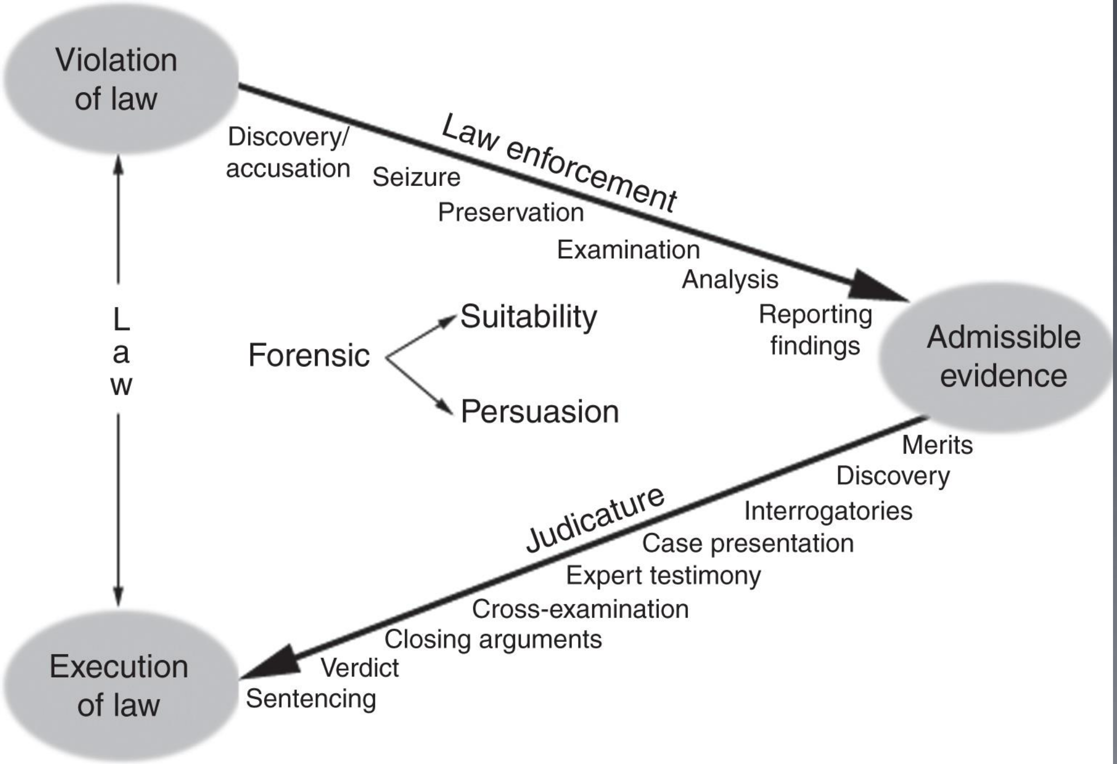
USDOJ (*US Department of Justice*):

- hardware as Contraband or Fruits of Crime
- hardware as an Instrumentality
- hardware as Evidence
- information as Contraband or Fruits of Crime
- information as an Instrumentality
- information as Evidence

Digital evidence in court

chapter 3

Digital evidence in court



Tasks of an expert

- presentation of evidence material:
  - do not succumb to influences
  - to reject prematurely set theories
  - use of scientific truth for the needs of the legal process
- ACM Code of ethics
- IEEE Code of ethics

Admissibility

- five basic rules:
  1. relevance of the material for the case
  2. authenticity of the material *(capture, traceability, ...)*
  3. not hearsay or admissible hearsay *(the evidence is not hearsay unless the speaker is present)*
  4. the best possible evidence *(original and copy)*
  5. not unduly prejudicial
- search warrant

Levels of Certainty

- we have a record in the notes:

```
2009-04-03 02:28:10 W3SVC1 10.10.10.50 GET
   /images/snakeoil13.jpg-80-192.168.1.1
   Mozilla/4.0+(compatible;+MSIE+6.0;Windows+NT+5.1) 200
   0 0
```

- what do we conclude from it?

- levels of Certainty:

  - (1) almost definitely; (2) most probably; (3) probably; (4) very possibly; (5) possibly

  - statistical probability

Computer Legislation

chapter 4

- legislation USA
  - 50 legislations
  - Washington DC legislation
  - federal legislation

Computer Legislation

chapter 5

- legislation ES (*EU*)
  - Ireland and Great Britain separate system – *common law*
  - the rest of the countries – *civil law*
- common legislation:
  - parliament EU
  - Convention on Cybercrime, 1. July 2004
    - has not been ratified by Ireland and the United Kingdom
  - Protocol on acts of racism and xenophobia, 1. March 2006

Crimes over the integrity of the computer

- Access to a computer is not allowed unless authorized by the owner
- Examples:
  - hackers
  - stealing data
  - intercepting data
  - Influencing data and/or systems (DOS, viruses)
  - ››incorrect‹‹ or unintentional use of the unit/device

Crimes with the help of computers

- forgery
- fraud
- abuse

Crimes related to data content

- Crimes that affect the content of the data
  - child pornography
  - web seduction
  - racism and xenophobia

Other crimes

- copyright infringement
- computer blackmail
- …