Privacy, Identity, Computational Forensics

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other security-related courses

- **89-3552 Security Engineering**
  - protocols, rights, cryptography, security
- **89-4252 Security in Distributed Systems**
  - cryptography, protocols
- **89-4253 Security in Wireless Networks**
  - wireless security, protocols, authetication
- **(anything else?)**

this course

- information theory
- statistical tests
- machine learning
- pattern recognition
- risk estimates
- side channels
- physics and randomness
- psychology and economics

this course

- what is possible?
- how does it work?
- how well does the technology work?
- how can it be used / mis-used?
- what are the challenges?
- what countermeasures are there?

course mechanics

- 2+0 course, once a week
- active participation required
- collect information and contribute
- some computer exercises (Python)

EXAMPLE:

FACE DETECTION & RECOGNITION

face detection & recognition

- **given an image...**
  - find all the faces
  - find the same face in multiple images
  - assign names & identities to those faces
- **security & forensic applications**
  - given an image of a suspect, search mugshot databases
  - spot terrorists in public places
- **but...**

Picasa™ Web Albums | My Photos | People | Explore | Upload

Name tags: **All People**

People: R. **Album:** All Albums

R. (1)
R. Ma ha@cs du

Edit contact
Correct name tag mistakes

Use the checkboxes below to select faces of one person. Select: All None

Enter name: Apply

Suggestions: R. Todd Henry Choose

Don't want to name a face?
Mark selected faces as: Ignore Not a Face

web photo applications

- **consumer application & convenience**
  - people upload their snapshots
  - system identifies faces
  - people label faces of friends with names + email
- **implications?**
  - what can Google use this data for?
  - who else can use this data?
  - how well does it actually work?
  - better than a police mugshot database?

organization

- **course is organized by applications**
- **cross-cutting & recurring**
  - users, targets, measures, counter-measures
  - false alarms and false negatives
  - cost and economic factors
  - statistical analysis & risk analysis
  - pattern recognition & machine learning methods
  - image processing
  - human factors, psychology, perception
  - physics, sensors, randomness

IMAGE-RELATED TOPICS

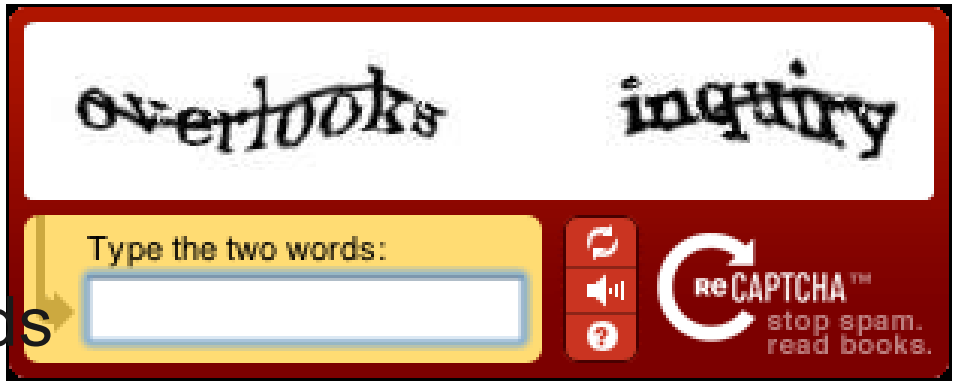
steganography & watermarking

- **hide information in images, text, etc.**

- **applications**
  - covert communications
  - hiding illegal materials
  - tracking / copyright enforcement
  - espionage
  - information leak detection

CAPTCHA, RTTs, Mech. Turks

- **limit access to services to humans**
- **issues**
  - how does it work?
  - who is using it?
  - what is it used for?
  - can it perform useful computation?
  - what are the limitations?
  - how can it be broken?
  - what about accessibility?
  - can we build better ones?
  - visual authentication/passwords



detecting photo manipulation

- **is it real or manipulated?**
- **issues**
  - kinds of manipulations?
  - legal applications?
  - mechanisms of detection?
  - circumvention of detection?
  - cryptographic alternatives?

printer & camera identification

- **find model & identity of device from images**
- **issues**
  - devices: printers, cameras, scanners
  - identification from metadata
  - identification from physical characteristics
  - building forensic device databases
  - identification from social network sites
  - interaction with Flickr, Picasa, etc.
  - countermeasures to identification
  - impersonation & framing

optical document security

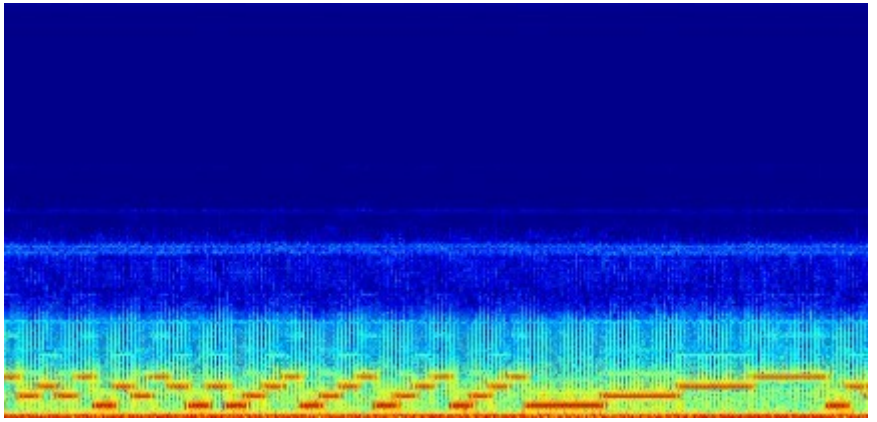
- **traditional means for securing documents**
- **issues**
  - goals and threat models
  - physical randomness
  - special paper, fibers, chads, etc.
  - holograms, gratings, threads, etc.
  - special manufacturing processes
  - visual distinguishability
  - limitations of copiers and printers

biometric identification

- **identification from fingerprints, faces, ...**
- **issues**
  - different types of biometric identifiers
  - physical & biological randomness
  - access control
  - positive and negative errors
  - usability and user acceptance
  - countermeasures
  - sensors
  - cost

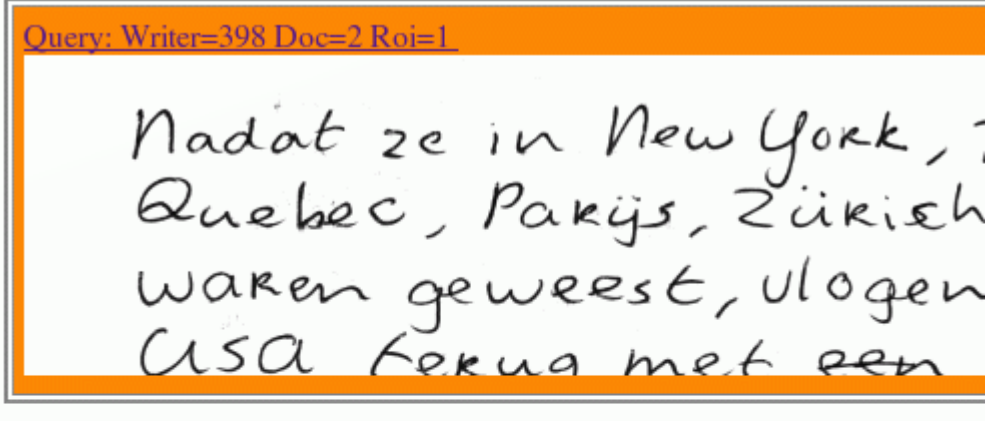
information leaking

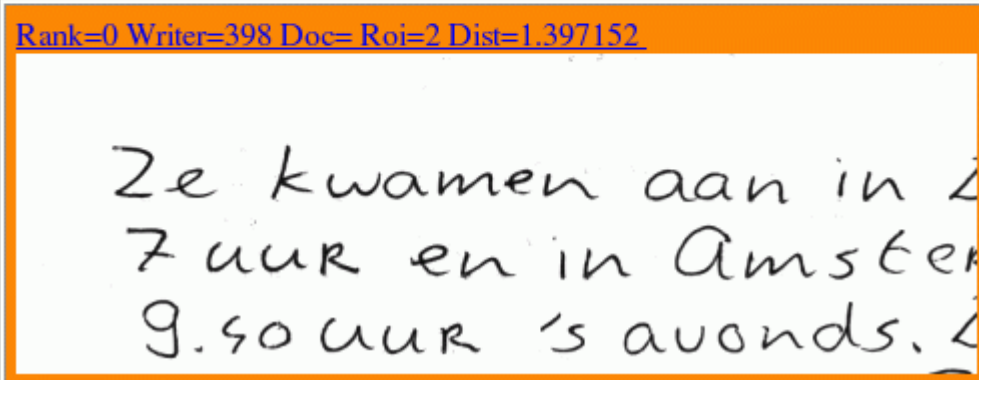
- **“secure” protocols leak information**
- **examples**
  - recovering passwords from encrypted ssh sessions
  - keystrokes from keyboard sounds
  - keystrokes from electrical noise
  - screen content from radio signals
  - distant sound capture with lasers
- **issues**
  - how do these work?
  - how well do they work?
  - countermeasures?



handwriting identification

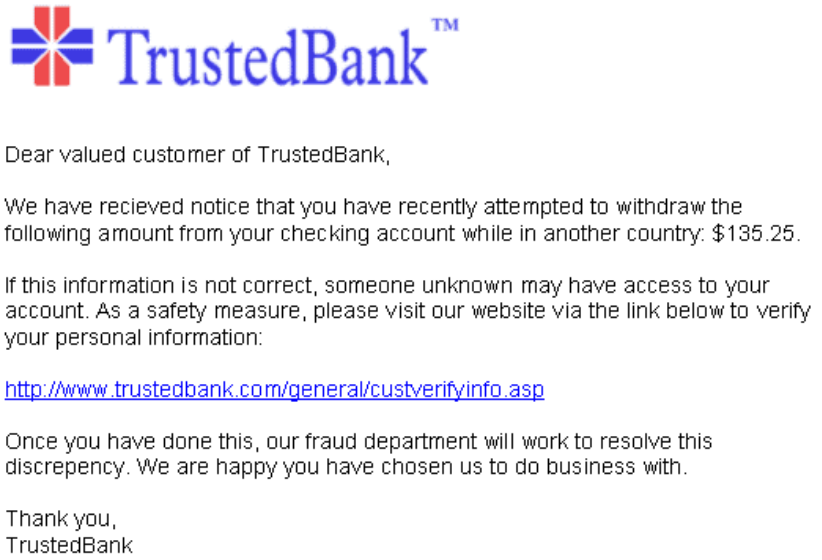
- **sample writing → writer identity**
- **issues**
  - “expert” methods & validation
  - automated approaches
  - forensic applications
  - positive and negative errors
  - validation
  - active countermeasures





phishing

- **tricking people into doing the wrong thing**
- **issues**
  - how are people tricked?
  - psychology and cognitive issues?
  - how does this relate to images?
  - countermeasures?



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Dear valued customer of TrustedBank,

We have recieved notice that you have recently attempted to withdraw the following amount from your checking account while in another country: $135.25.

If this information is not correct, someone unknown may have access to your account. As a safety measure, please visit our website via the link below to verify your personal information:

http://www.trustedbank.com/general/custverifyinfo.asp

Once you have done this, our fraud department will work to resolve this discrepency. We are happy you have chosen us to do business with.

Thank you,
TrustedBank

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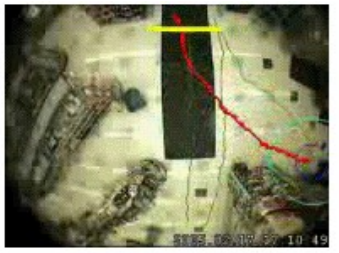
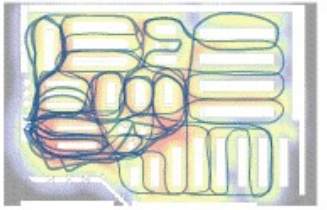
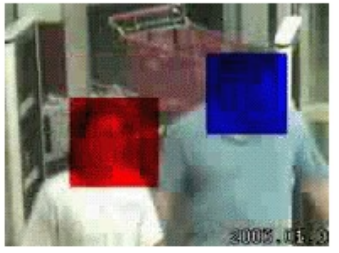
multimedia mining

- **retrieve information from databases/streams**
- **issues**
  - identifying people, locations, activities
  - approaches & their performance
  - pornography detection
  - mining Flickr, YouTube, Facebook
  - real-time surveillance & terrorism de
  - multimedia forensic data analysis
  - database architectures
  - copyright infringement (YouTube)



location & tracking

- **determining location of people & devices**
- **issues**
  - GPS technology
  - localization based on radio signals (WiFi, GSM, ...)
  - localization based on images, sound, etc.
  - building location bases
  - geolocated images
  - forensic image locations
  - device and RFID tracking
  - WiFi-based imaging

security inspection

- **detect weapons & explosives**
- **issues**
  - detecting guns, liquids, explosives, detonators
  - 3D imaging
  - X-ray imaging
  - THz imaging
  - usability issues
  - privacy issues (“screener porn”)

TEXT-RELATED TOPICS

text mining & filtering

- **categorize, detect, identify text content**
- **applications & issues**
  - what is being detected?
  - how is it being detected?
  - named entity detection
  - real-time spam detection & filtering
  - real-time automated censorship
  - CARNIVORE (US, NSA), Great Wall (China), ...
  - censorship circumvention
  - DOS attacks on censorship
  - organizations and political dimension

authorship identification

- **given a text sample, identify its author**
- **issues**
  - historical authorship determination
  - de-anonymization of postings
  - entity-based de-anonymization
  - the AOL query log disaster
  - attribution of forensic evidence, texts
  - impersonation and forgeries
  - identify attributes of the author: skill, bilingualism, etc.

text mining & intelligence analysis

- **support human analysts w/large corpora**
- **applications & issues**
  - philology — TextGrid
  - forensic & intelligence analysis
  - open source analysis
  - scientific text mining
  - text categorization
  - topic identification
  - named entity recognition
  - copy and plagiarism detection

social network & traffic analysis

- **who links/talks to whom?**
- **issues**
  - visualization & support for analysts
  - statistical methods and machine learning
  - ex.: sexual orientation from social networks
  - privacy implications
  - countermeasures
  - balance between privacy and utility

forensic data mining

- **identify individuals/attributes from database**
- **issues**
  - national security, “Rasterfahndung”, insurance applications
  - ad placement and recommender systems (Google)
  - epidemiological & sociological applications
  - statistical and data mining techniques
  - anonymization, reproducibility, validation of results
  - data sources and connecting different data sources
  - errors and their statistical consequences
  - risks, costs, and conflicting interests
  - minimum information necessary to identify a person

NOW?

prepare for next lecture

- try out face recognition in PicasaWeb
- estimate capabilities, error rates
- legitimate uses/services?
- legal issues/rights?
- potential forensic use?
- threat/risk scenarios?