Access Control and Privacy Policies (9)

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Slides: KEATS (also homework is there)

Last Week

Recall, the Schroeder-Needham (1978) protocol is vulnerable to replay attacks.

$$A \rightarrow S : A, B, N_A$$
$$S \rightarrow A : \{N_A, B, K_{AB}, \{K_{AB}, A\}_{K_{BS}}\}_{K_{AS}}$$
$$A \rightarrow B : \{K_{AB}, A\}_{K_{BS}}$$
$$B \rightarrow A : \{N_B\}_{K_{AB}}$$
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Fix: Replace messages 2 and 3 to include a timestamp:

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Denning-Sacco Protocol

Denning-Sacco (1981) suggested to add the timestamp, but omit the handshake:

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they argue A and B can check that the messages are not replays of earlier runs, by checking the time difference when the protocol is last used

Denning-Sacco-Lowe Protocol

Lowe (1997) disagreed and said the handshake should be kept, otherwise:

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When is this a problem?

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\end{aligned}
$$

When is this a problem?

Assume B is a bank and the message is "Draw £1000 from A's account and transfer it to I."

Privacy

- we do want that government data is made public (free maps for example)
- we do not want that medical data becomes public (similarly tax data, school records, job offers)

- personal information can potentially lead to fraud (identity theft)

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"The reality":

- London Health Programmes lost in June unencrypted details of more than 8 million people (no names, but postcodes and details such as gender, age and ethnic origin)

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"The reality":

- also in June Sony got hacked: over 1M users' personal information, including passwords, email addresses, home addresses, dates of birth, and all Sony opt-in data associated with their accounts.

Privacy and Big Data

Selected sources of "Big Data":

- Facebook
  - 40+ Billion photos (100 PB)
  - 6 Billion messages daily (5 - 10 TB)
  - 900 Million users
- Common Crawl
  - covers 3.8 Billion webpages (2012 dataset)
  - 50 TB of data
- Google
  - 20 PB daily (2008)
- Twitter
  - 7 Million users in the UK
  - a company called Datasift is allowed to mine all tweets since 2010
  - they charge 10k per month for other companies to target advertisement

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Scare Tactics

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Netflix Prize

Anonymity is necessary for privacy, but not enough!

- Netflix offered in 2006 (and every year until 2010) a 1 Mio $ prize for improving their movie rating algorithm
- dataset contained 10% of all Netflix users (appr. 500K)
- names were removed, but included numerical ratings as well as times of rating
- average user rated 200 movies
- some information was perturbed (i.e., slightly modified)

All OK?

Re-identification Attack

Two researchers analysed the data:

- with 8 ratings (2 of them can be wrong) and dates that have a 14-day error, 98% of the records can be identified
- for 68% only two ratings and dates are sufficient (for movie ratings outside the top 500)

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- they took 50 samples from IMDb (where people can reveal their identity)
- 2 of them uniquely identified entries in the Netflix database (either by movie rating or by dates)

- Birth data, postcode and gender (unique for 87% of the US population)
- Preferences in movies (99% of 500K for 8 ratings)

Therefore best practices / or even law:

- only year dates (age: 90 years or over),
- no postcodes (sector data is OK, similarly in the US)
  no names, addresses, account numbers, licence plates
- disclosure information needs to be retained for 5 years

How to Safely Disclose Information?

- Assume you make a survey of 100 randomly chosen people.
- Say 99% of the people in the 10 - 40 age group have seen the Gangnam video on youtube.
- What can you infer about the rest of the population?

How to Safely Disclose Information?

- Is it possible to re-identify data later, if more data is released.

- Not even releasing only aggregate information prevents re-identification attacks. (GWAS was a public database of gene-frequency studies linked to diseases; you only needed enough data about phenotype (hair, eyes, skin colour...) in order to identify whether an individual was part of the study — DB closed in 2008)

Differential Privacy

User

tell me $f(x) \Rightarrow$

$\Leftarrow f(x) + \text{noise}$

Database

$x_1, \ldots, x_n$

- $f(x)$ can be released, if f is insensitive to individual entries $x_1, \ldots, x_n$
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- Noised needed in order to prevent:
  Christian's salary $=$
  Σ all staff $-$ Σ all staff $\setminus$ Christian

Adding Noise

Adding noise is not as trivial as one would wish:

- If I ask how many of three have seen the Gangnam video and get a result as follows

Alice	yes
Bob	no
Charlie	yes

then I have to add a noise of 1. So answers would be in the range of 1 to 3

- But if I ask five questions for all the dataset (has seen Gangnam video, is male, below 30, ...), then one individual can change the dataset by 5

Tor, Anonymous Webbrowsing

- initially developed by US Navy Labs, but then opened up to the world
- network of proxy notes