Privacy, Systems, Humans, and Cybernetics: A (Brief) Overview of Technical, Economic, Social, Cultural, and Psychological Aspects of Privacy

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1. Challenges Related to Privacy: Overview

- Our Systems, Man, and Cybernetics Society focuses on the following challenges which are relevant to our society’s mission:
  - technical challenges,
  - economic and social challenges,
  - cultural and psychological challenges.

- In this talk, we show:
  - how these challenges are related to the main objectives of our society, and
  - what partial results we have in solving these challenges.
2. Technical Aspects of Privacy

- To gain useful information – e.g., about diseases – we need to process data from several people.

- In this case, a guaranteed way to preserve privacy is not to store exact data, but to store approximate data.

- For example, instead of the exact birthdate, we only store whether a person is 20-30 or 30-40 etc.

- The usual requirement is $k$-anonymity – for each set of data points, at least $k$ different people can fit this set.

- This modification of data solves the privacy problem, but it leads to new challenges.
3. First Algorithmic/Computational Challenge: Estimating Privacy-Caused Inaccuracy

- The values that we process are only approximately equal to the actual ones.
- So, the results of processing them are also only approximately equal to what we would get if we had exact data.
- Estimating the accuracy of this approximation is the first computational challenge.
4. Second Algorithmic/Computational Challenge: Minimizing Privacy-Caused Computational Complexity

- In general, the corresponding estimation problem is computationally difficult.
- Often, this problem is NP-hard.
- So, the second challenge is to select a way of approximating data that would make the corresponding computations feasible.
5. Third Algorithmic/Computational Challenge: Minimizing Privacy-Caused Inaccuracy

- For each value $k$, there are many different approximation methods that lead to this $k$.

- Examples:
  - we can have 20-30-type intervals for age and 180-185-type intervals for weight, or
  - we could have 20-25-type intervals for age and 180-190-type for weight.

- The third challenge is selecting the approximation scheme that would minimally effect the desired data processing result.

- Example: we want to maximize the efficacy of a certain treatment.
6. References


7. References (cont-d)


8. References (cont-d)

  
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9. References (cont-d)

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10. References (cont-d)


11. Algorithmic/Computational Challenges and SMC Society

All these algorithmics and optimization challenges relate to the general Cybernetics aspect of our society.

- Even with approximations, some personal information is revealed.

- It is desirable to select the approximation scheme for which the revealed partial information would be the least important.

- A naive approach is to minimize the number of bits.

- However, this number can be misleading:
  - revealing the first digit of a person’s income provides the public with a good estimate of this income, while
  - revealing the last digit does not do any harm.

- It is important to develop an economic-, utility-based criterion for gauging partial loss of privacy.

- The above estimate was about situations when people do not want to disclose information.
- However, in many cases, people are willing to disclose a little bit of private information if they are properly compensated for this.
- For example, people fill surveys if as a result, they get a discount or a gift card.
- A problem is that people often do not understand the true value of their shared information.
- So, they share it for a small portion of what it is really worth.
- How to provide a fair estimate of economic value of these disclosures is another important challenge.
14. References

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15. References (cont-d)

16. Economic/Social Challenges and SMC Society

All these economic and social challenges relate to the System and Human ("Man") aspects of our society.
17. Cultural and Psychological Challenges

- Most ideas of privacy are reasonably new.
- The US Supreme Court managed to find justification of privacy in the 18th century US Constitution.
- However, in reality, these ideas are much newer.
- Because of this newness, there is a strong cultural resistance to privacy ideas: *honest people have nothing to hide.*
- An important challenge is to find a way to explain how privacy fits into the traditional cultural ideas – and it does.
18. Cultural and Psychological Challenges (cont-d)

- For example, theologists convincingly argue that:
  - when in the Bible, Balaam praises the tents of Israel,
  - (this story is known because it involves a talking donkey),
  - what he praises them for is not beauty – there were richer nations, with more beautiful tents,
  - what he praises is that their arrangement provides privacy.
19. References


All these cultural and psychological challenges relate to the Human ("Man") aspects of our society.
21. Conclusion

- There are many aspects of privacy.
- In our Systems, Man, and Cybernetics Society we focus on:
  - technical aspects of privacy,
  - economic and social aspects of privacy, and
  - cultural and psychological aspects of privacy.
- We fully realize that there are many other aspects of privacy.
- We are thankful to IEEE for focusing on this important issue.
- We will be glad to collaborate with other societies on privacy-related issues.