Use Privacy in Data-Driven Systems

Theory and Experiments with Machine Learnt Systems

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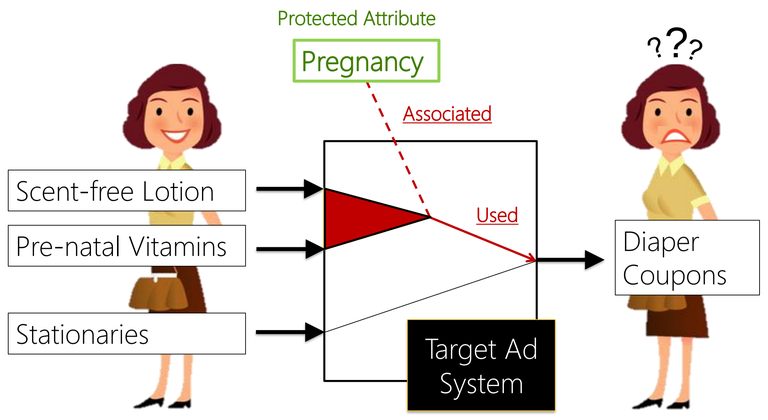
Learning Systems Threaten Privacy

Credit	Web systems	Healthcare
Education	Law Enforcement	Personalized privacy assistance
IoT Applications	…	…

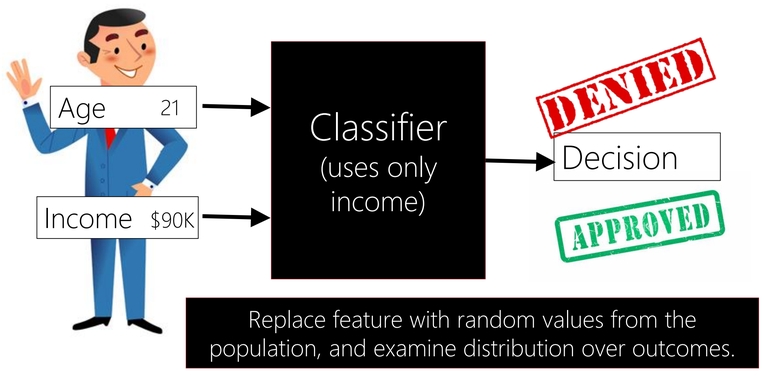


Using pregnancy status (inferred via past purchases) for marketing [Target 2012]

Need theories to define **'use restrictions'** for the protected information type in algorithmic decision making systems.

Explicit Use

Quantitative Input Influence*

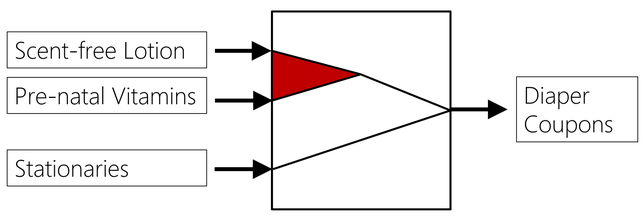


Replace feature with random values from the population, and examine distribution over outcomes.

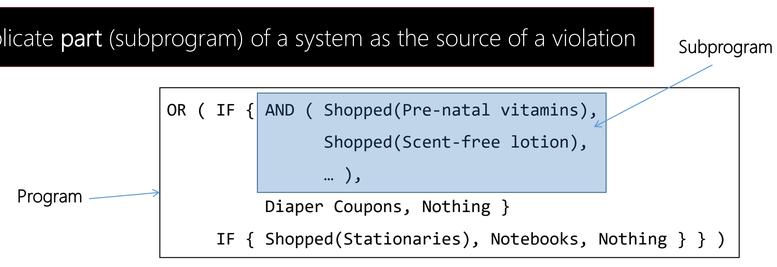
*Anupam Datta, Shayak Sen, Yair Zick. *Algorithmic Transparency via Quantitative Input Influence*. Oakland'16

Proxy (or implicit) Use

Learning Systems as Programs



Implicate **part** (subprogram) of a system as the source of a violation



Two-Phase Definition

Association — *Is a subprogram associated to the protected attribute?*

➔ Well-studied association measures (e.g., Mutual Information)

Use / Influence — *Is a subprogram influential to the output of the program?*

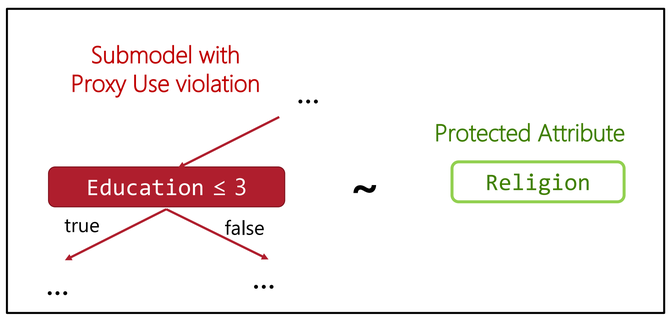
➔ QII for subprograms

(ϵ, δ)-Proxy Use: A subprogram with association level above ϵ, and influence measure above δ exists

Experiments

contra

Advertisement targeting using the Indonesian Contraception Dataset
- Features: `Education, Children, Husband's Job`, etc
- Classification: `Contraception Methods`
- Protected attribute (removed in training phase): `Religion`
- ~1,500 individuals

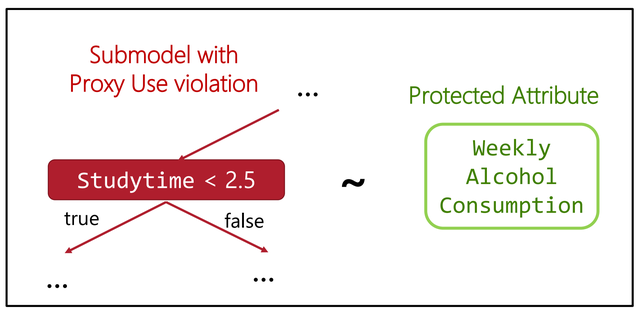


Education level used to target people in specific religion

➔ Concerning Use

student

Academic performance prediction using Portuguese Student Alcohol dataset
- Features: `Failures, Studytime, Father's education level, Health status`, etc
- Classification: `Grade`
- Protected attribute : `Weekly alcohol consumption`
- ~7,000 individuals



Study time used as a predictor for the academic performance

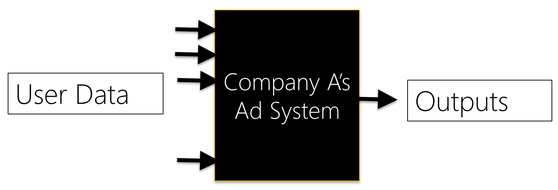
➔ Acceptable Use

Summary

- Use Privacy restricts use (*explicit* or *proxy)* of protected information type for *certain purposes* with *some exceptions*
- We implemented a software tool for detection and repair of use violations
  - Experimental validations with a few real dataset

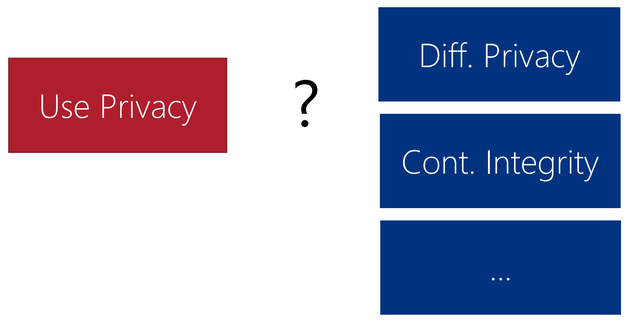
Directions

Black-box Models



Explore Utility Tradeoffs

Explore Relationship with Other Privacy Notion



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