PUI Perceptual User Interfaces

University of Stuttgart Germany

Private mouse and keyboard behavioral data

BSc intro

Hossam Elfar

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Perceptual User Interfaces Group, University of Stuttgart

www.perceptualui.org

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Who am I ?

- Hossam Elfar
- Student at the German University in Cairo (GUC).
- Media Engineering and technology (MET).
- hobbies : Playing Chess , Swimming

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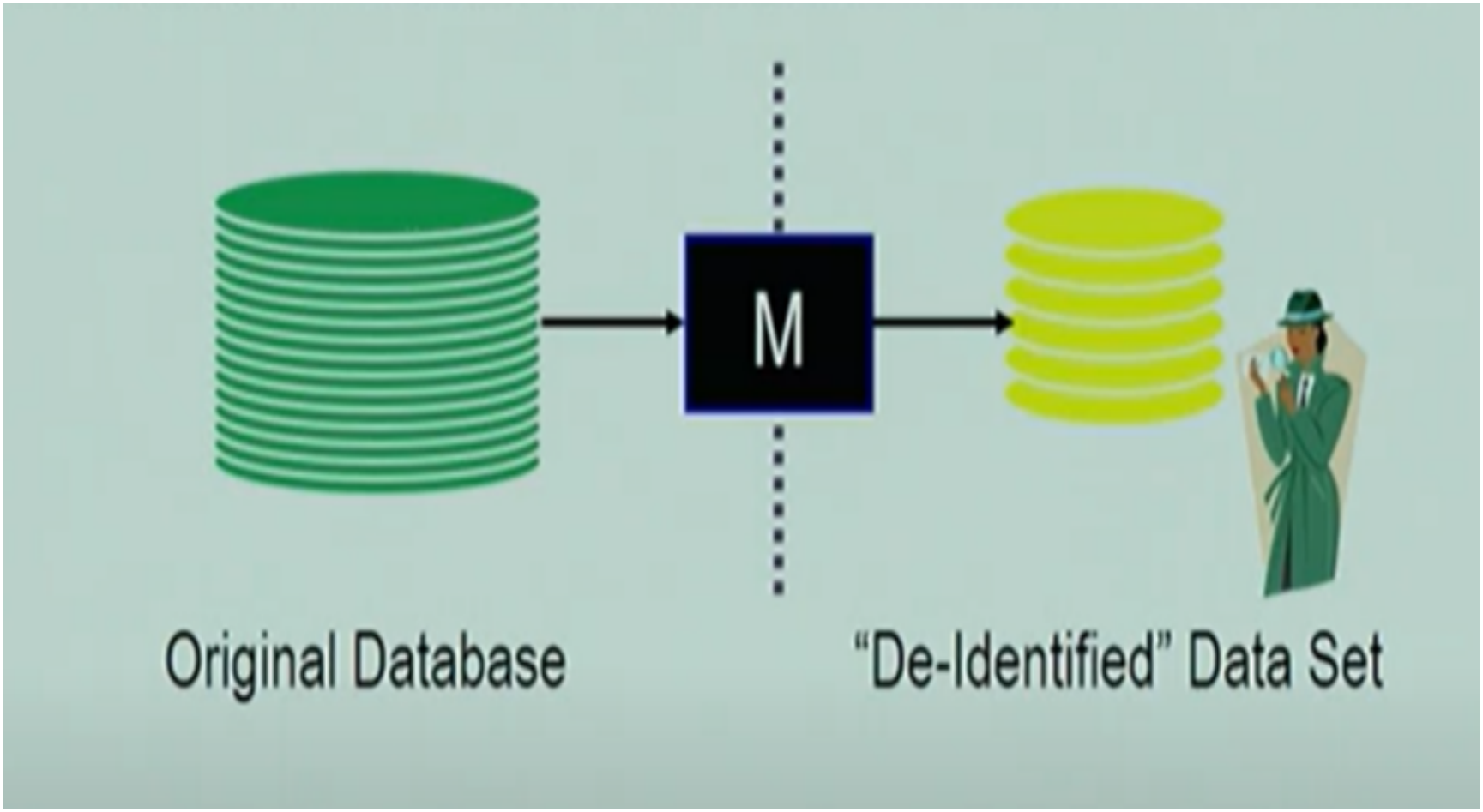
Behavioral datasets

Mouse and Keyboard dataset

- Effective behavioural biometrics for data analysis [Hanisch et al., 2021]
- Highly personally sensitive data such as usernames, passwords, banking information, or text messages
- Used as biometrics in active authentication and predicting user's intents [Sun and Upadhyaya, 2015]
- Limited prior work in privacy [Sánchez et al., 2020]


M
Original Database
"De-Identified" Data Set

Netflix Prize

But are these de-identified datasets actually private?

Why anonymisation isn't enough ?

Netflix Prize & Linkage attacks

Source: image from Simply Explained youtube channel

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Differential privacy

Differential privacy & remote data science

Our key contributions are two-fold:

We propose the first differential privacy [Dwork, 2008] approach for mouse and keyboard datasets and allow remote processing of mouse and keyboard behavioural data by performing remote data analysis.

(a) Mouse dataset of 20 users

Position : X >= 50 , Y >=30

Does John actually clicks on that position on the screen ?

Probability of people clicking on the position

Dataset → Model → 0.55

Dataset +john → Model → 0.57

Maybe john has clicked ?

Plausible deniability

(a) Mouse dataset of 20 users

Position : X >= 50 , Y >=30

Does John actually clicks on that position on the screen ?

Probability of people clicking on the position

Dataset → Model → 0.55

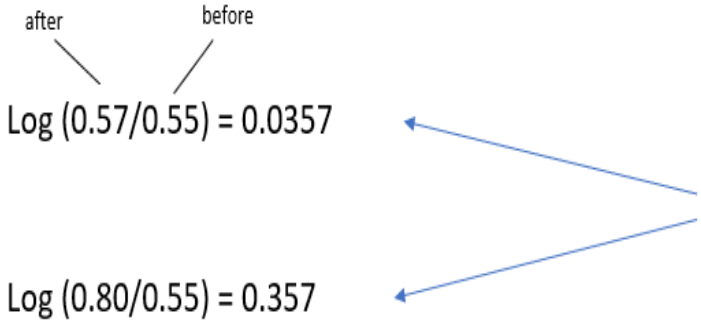
Dataset → Model → ~~0.57~~ 0.88

+john

john has clicked !

Privacy leak !

Privacy Loss

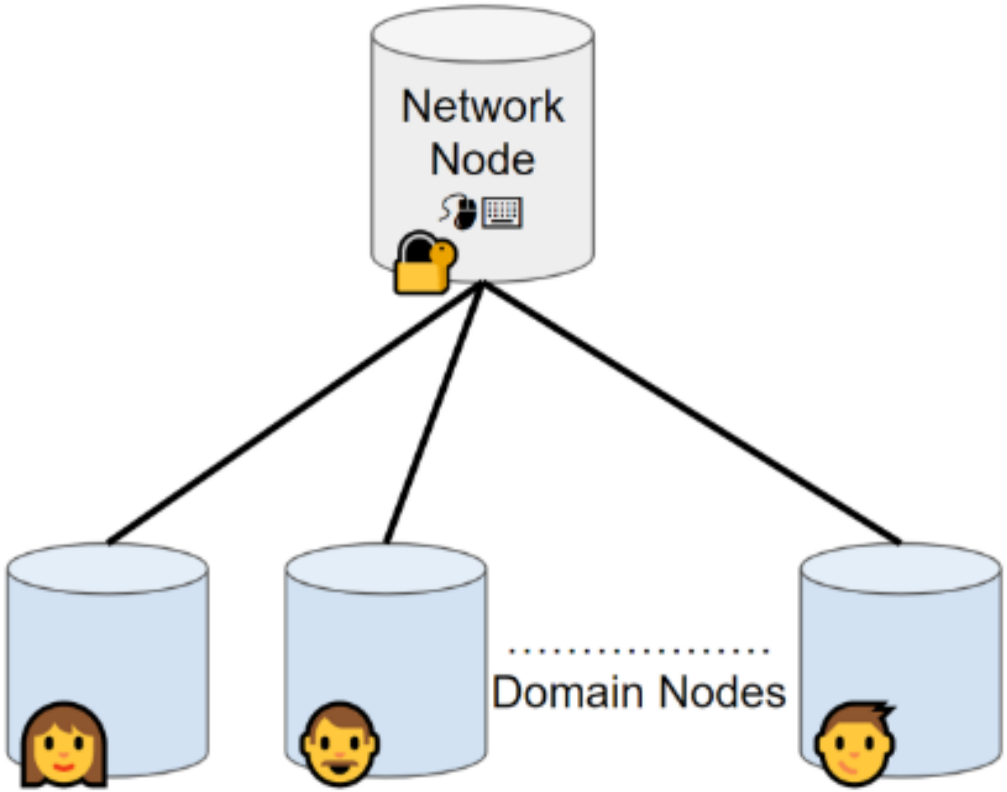


Differential privacy : Aims to limit this privacy loss!

- Log (probability after / probability before) <= **ε**
  Privacy budget
- Smaller budget = more private >>>> Larger budget = Learn more

Remote data science

- Deploy a domain node using HAGrid
- Deploy a network node that collects data from different domain nodes and handles the network requests using PySyft and PyGrid
- Allowing data owners to upload datasets to domain nodes.
- Obfuscating the data once uploaded via differential privacy
- Allow data scientists to log into the network, get a privacy budget, and run machine learning models.


Network
Node
Domain Nodes

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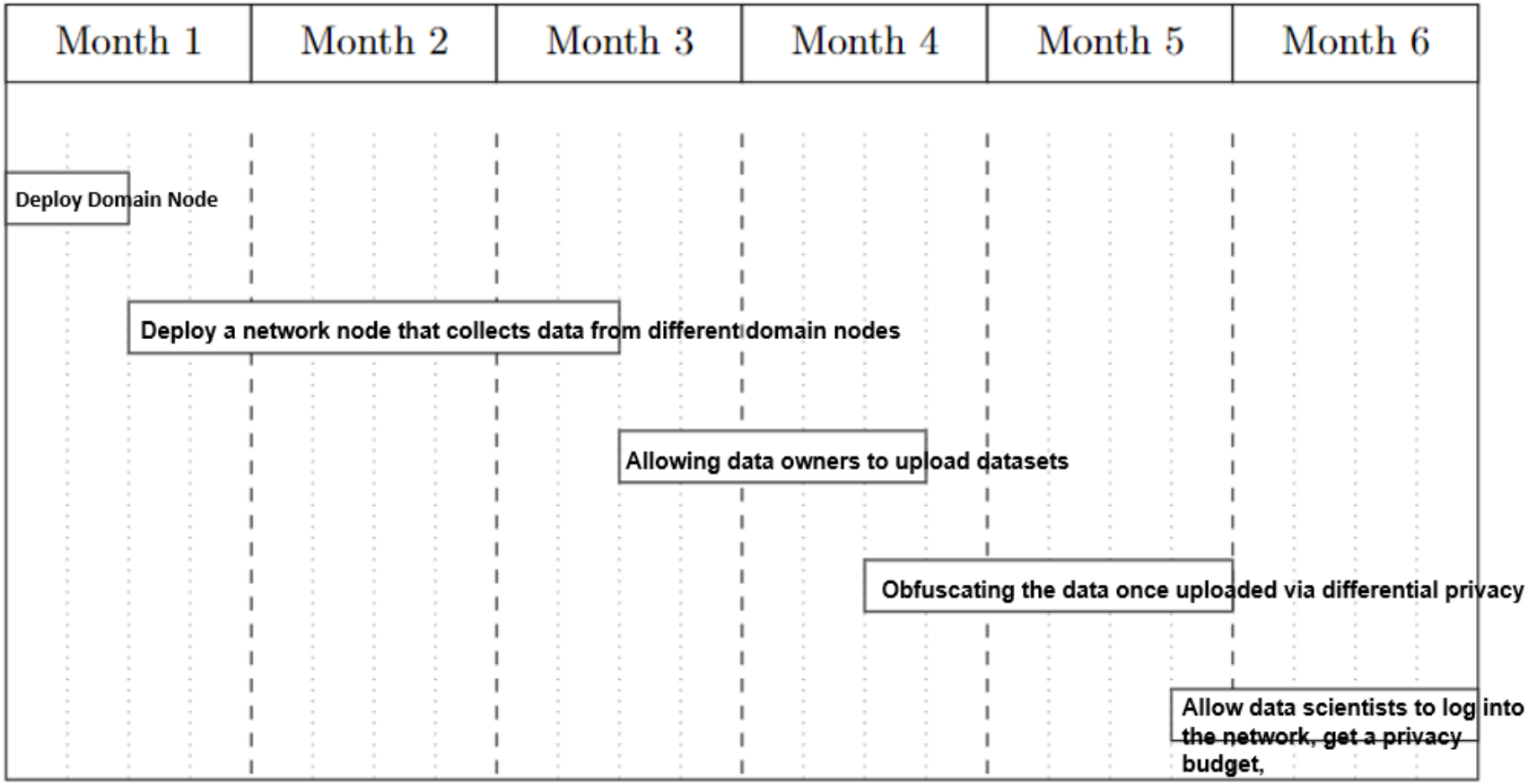
Schedule with milestones



References i

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