Comparative Study on Securing Biometrics Data

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MERIT BIEN SUMMER 2011
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MAST
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Motivation & Contribution

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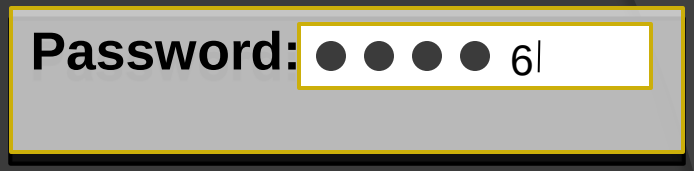
vs.

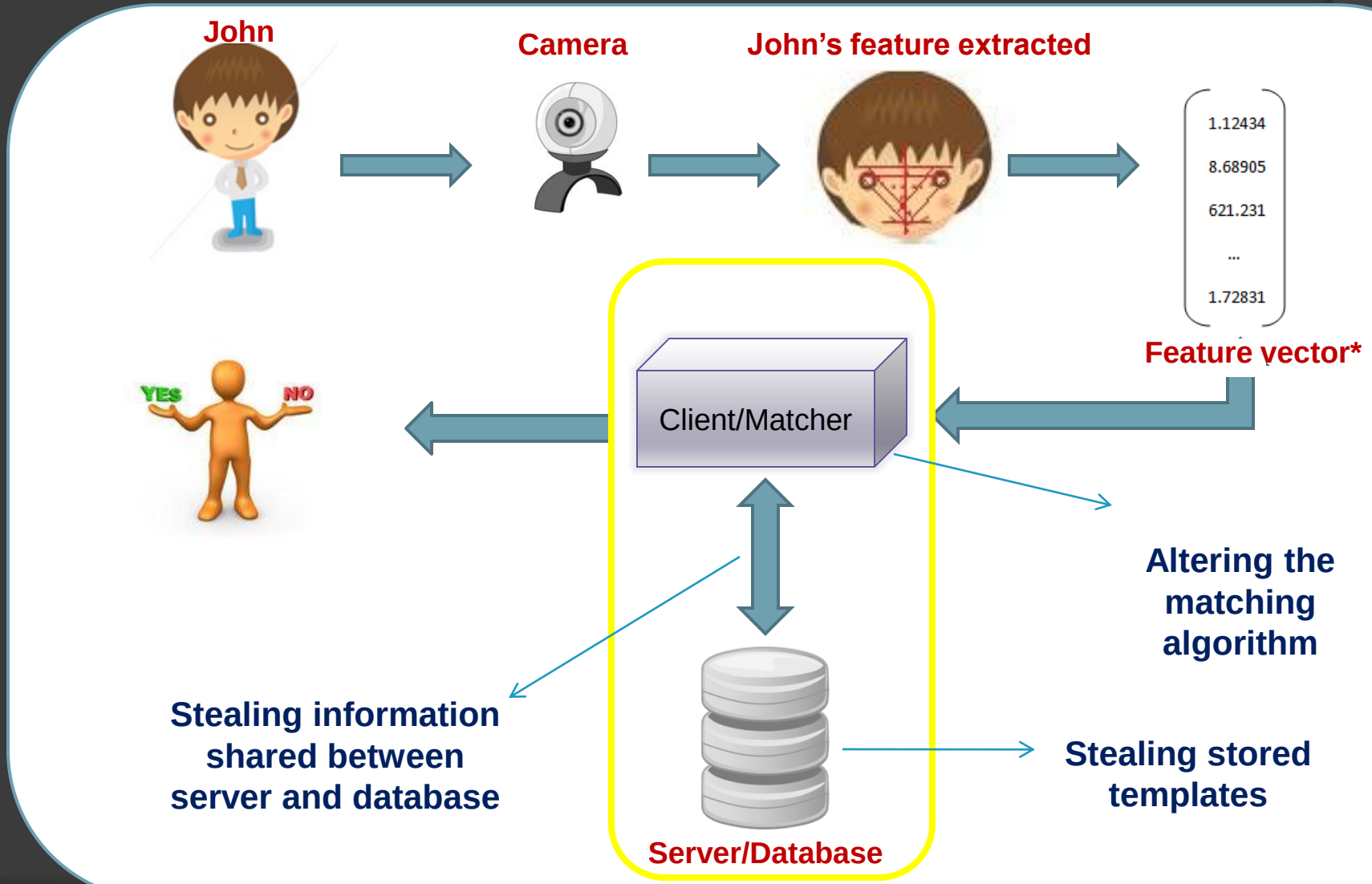


Useful but difficult to replace when compromised

Easy to crack, easy to steal, easy to replace

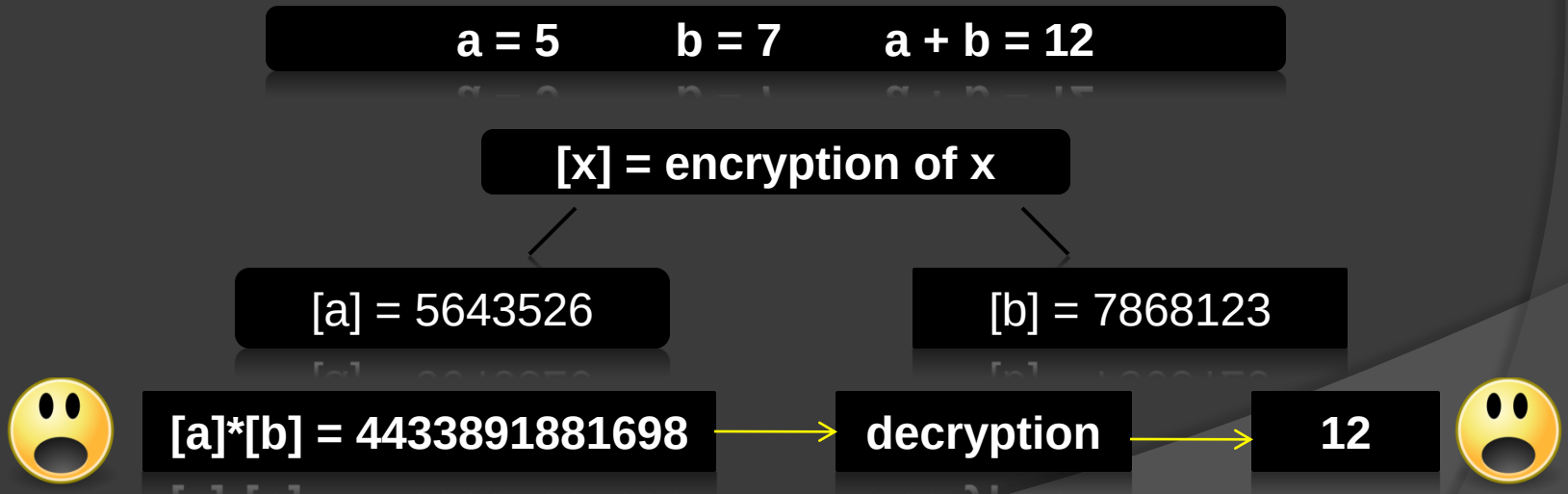
- Implementation of methods:
  1. Homomorphic Encryption & cryptographic protocol
  2. Random Projections
- Contribution: comparison and trade-off of methods
  1. Communication bandwidth
  2. Runtime
  3. Security strength & Matching accuracy
- Applications: Forensics, Identification, etc.

Points of Attacks



Homomorphic Encryption

- Traditional Encryptions: scramble to hide plaintext
- What is special about Homomorphic encryption?
  Enables certain processing/operations of encrypted data



HE- High Level Overview

Alice (Client)

Gives Bob [feature vector]

Euclidean Distance protocol

Minimum/Match Finding protocol

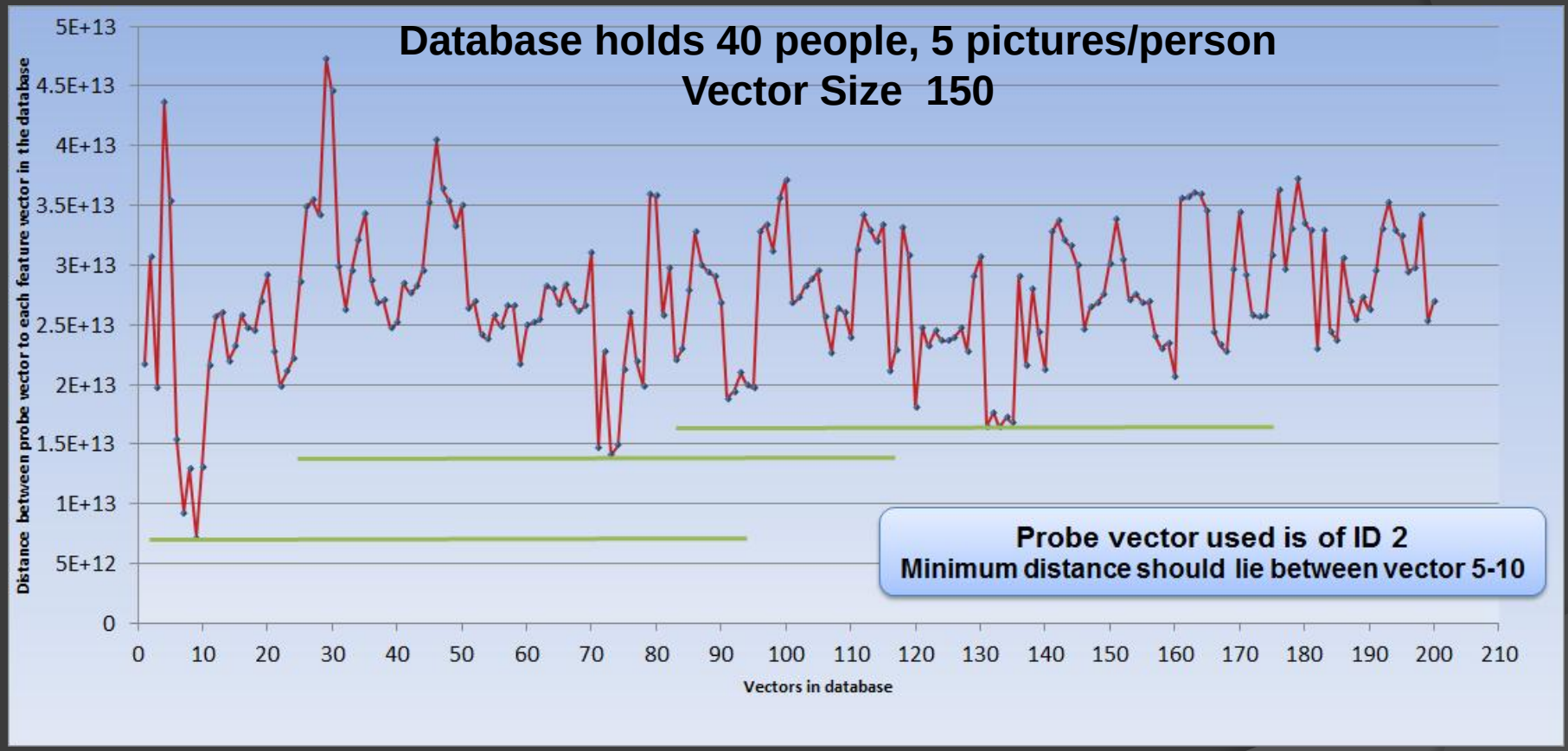
Bob (Server)

Area of Secure communication over an encrypted domain

Alice decrypts the ID

Give [Id] to Alice or 0

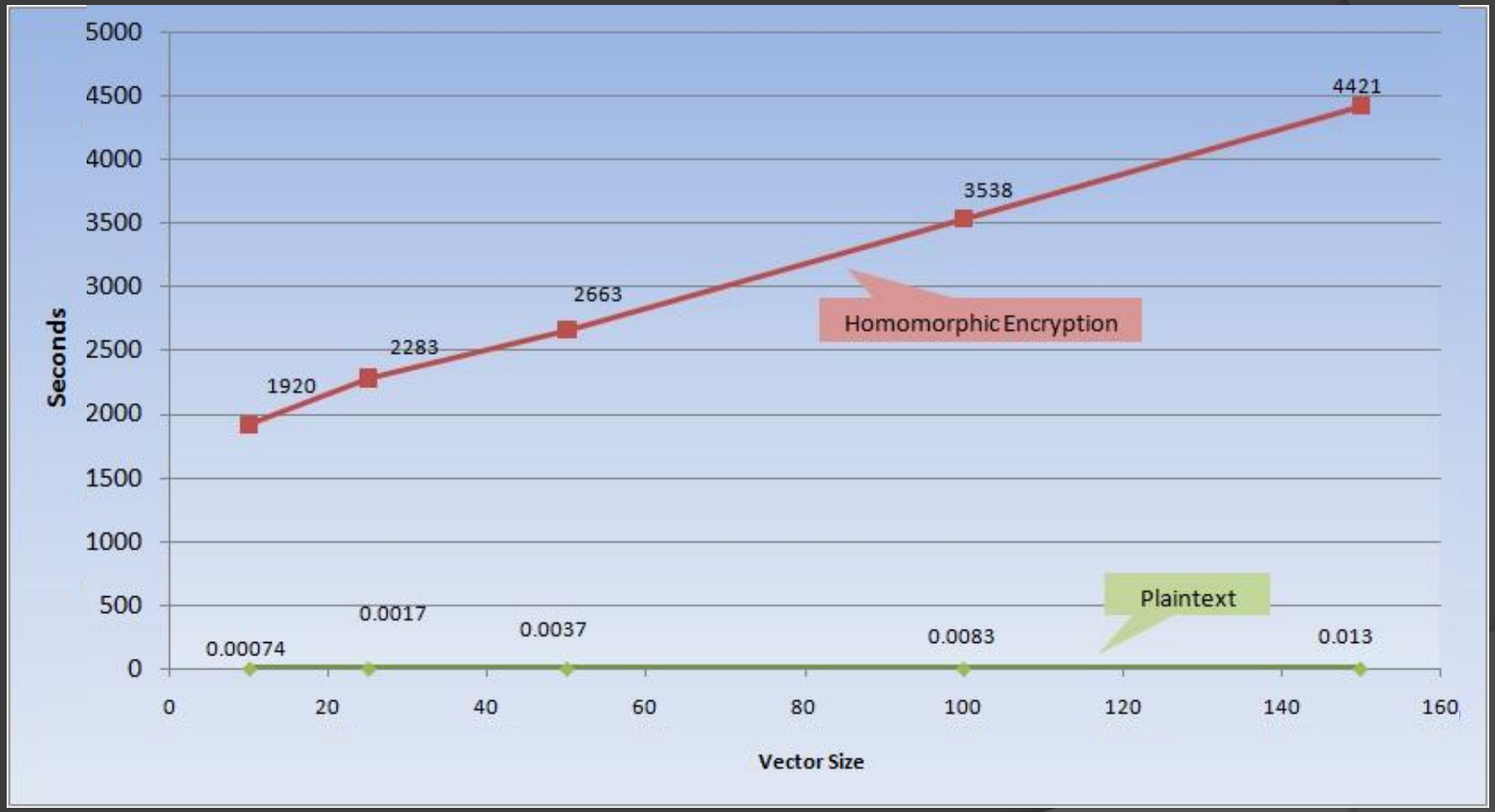
Distance Verification



Example of face variations/person:

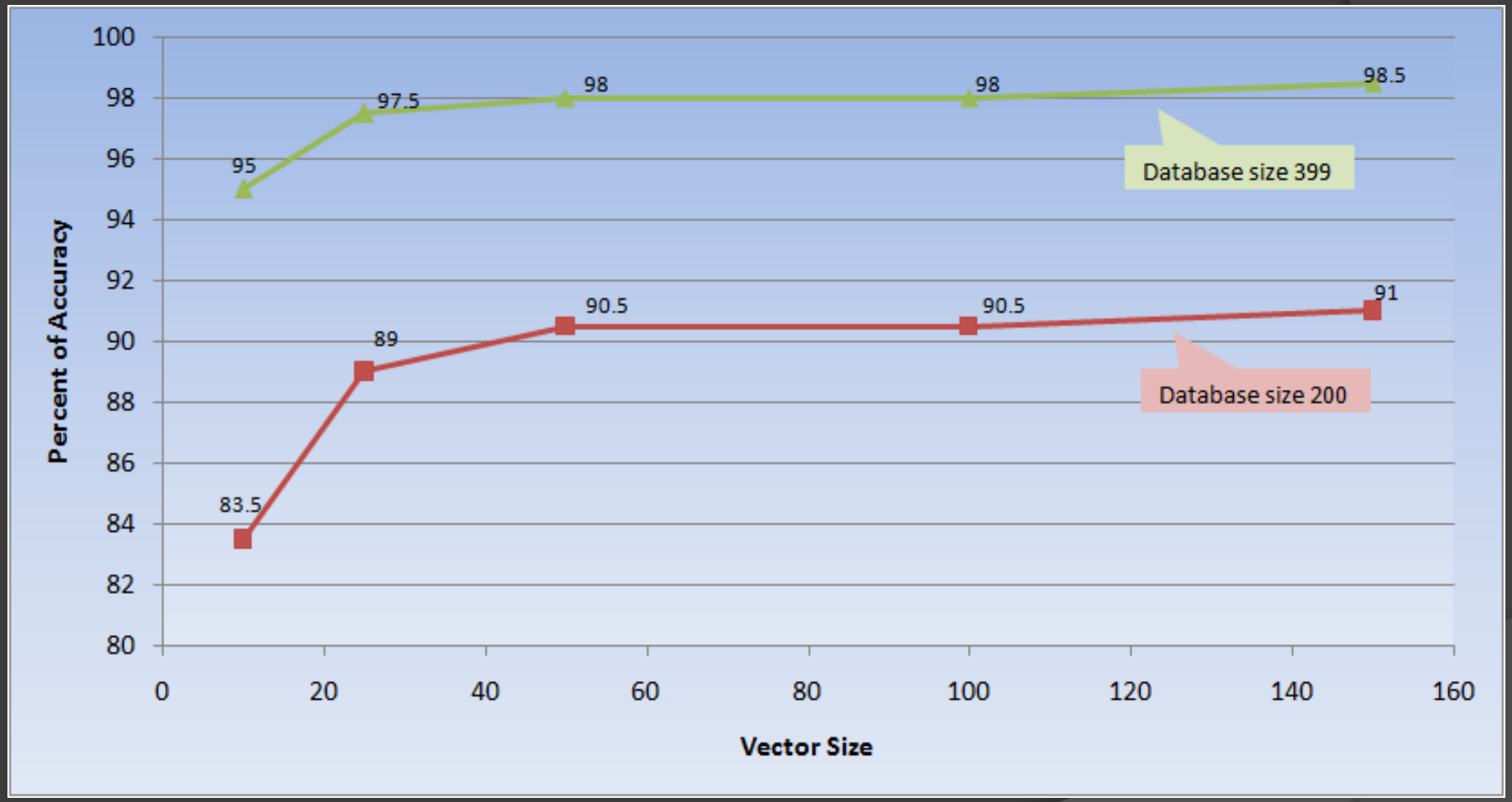
…

HE: Vector Size v. Time



Database Size = 200 (40 people, 5 vectors per ID)
Average time for one query out of 200 queries(runs)

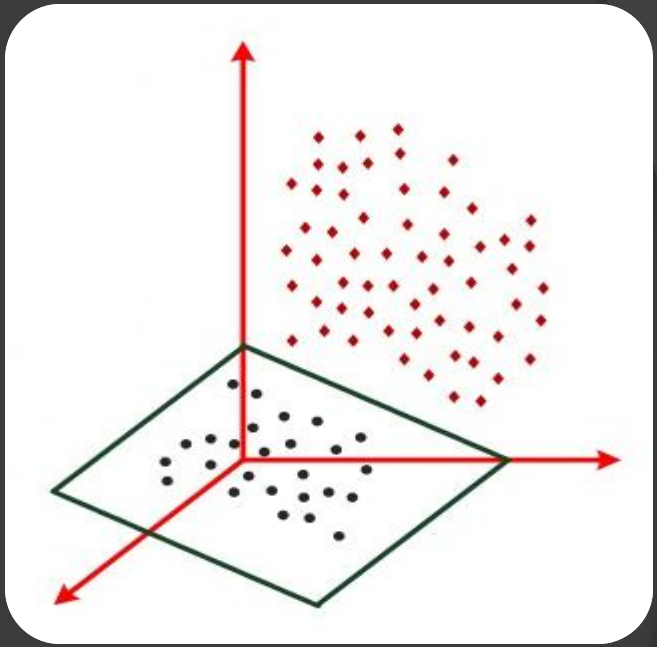
HE: Vector Size v. Accuracy



Database 200: 40 people, 5 representative variation pictures/person
Database 399: 40 people, 10 representative variation pictures/person

Random Projections

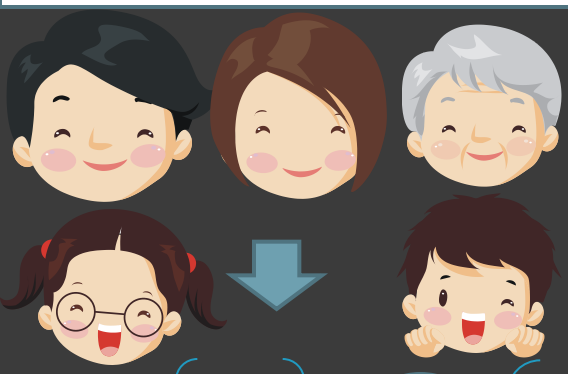
- The core computational method involved in Random Projection is matrix multiplication
- Gaussian, Bernoulli, or other random distribution matrix



$$y = \Phi g$$

Picture adapted from: http://www.ait.gr/ait_web_site/faculty/apne/Images/nonLinearlySeparable.jpg

RP: High Level Overview



Enrollment

$$\begin{bmatrix} 5 \\ \dots \\ 23 \end{bmatrix} \otimes \begin{bmatrix} 12 & 5 \\ \dots & \\ 7 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 24 \\ \dots \\ 11 \end{bmatrix}$$

$$\begin{bmatrix} 4 \\ \dots \\ 22 \end{bmatrix} \otimes \begin{bmatrix} 12 & 5 \\ \dots & \\ 7 & 1 \end{bmatrix} \rightarrow \begin{bmatrix} 23 \\ \dots \\ 12 \end{bmatrix}$$

Store TFV

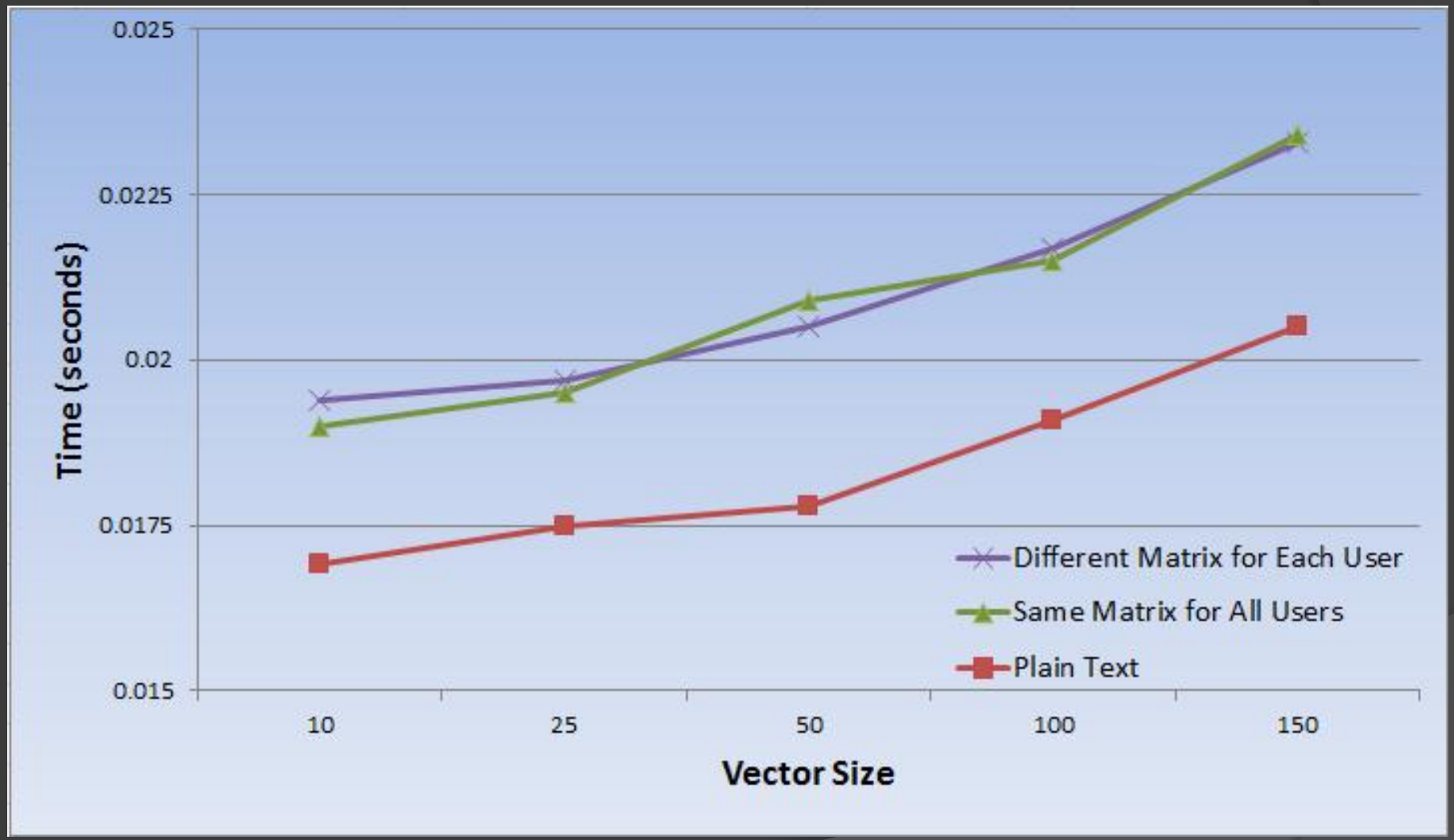
Database

Compare TFV

Yes (ID) or No

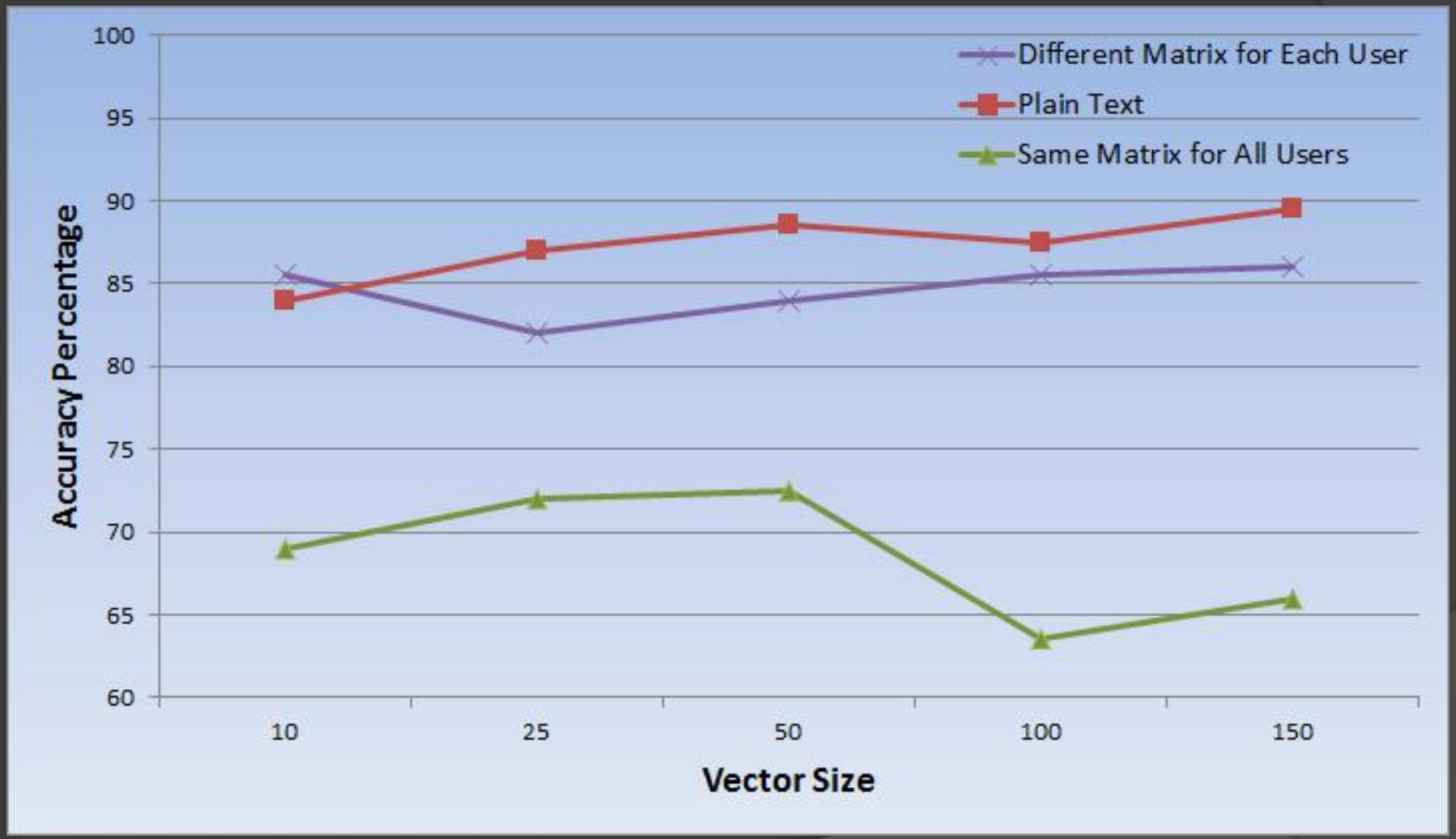
Verification

RP Verification: Vector Size v. Time



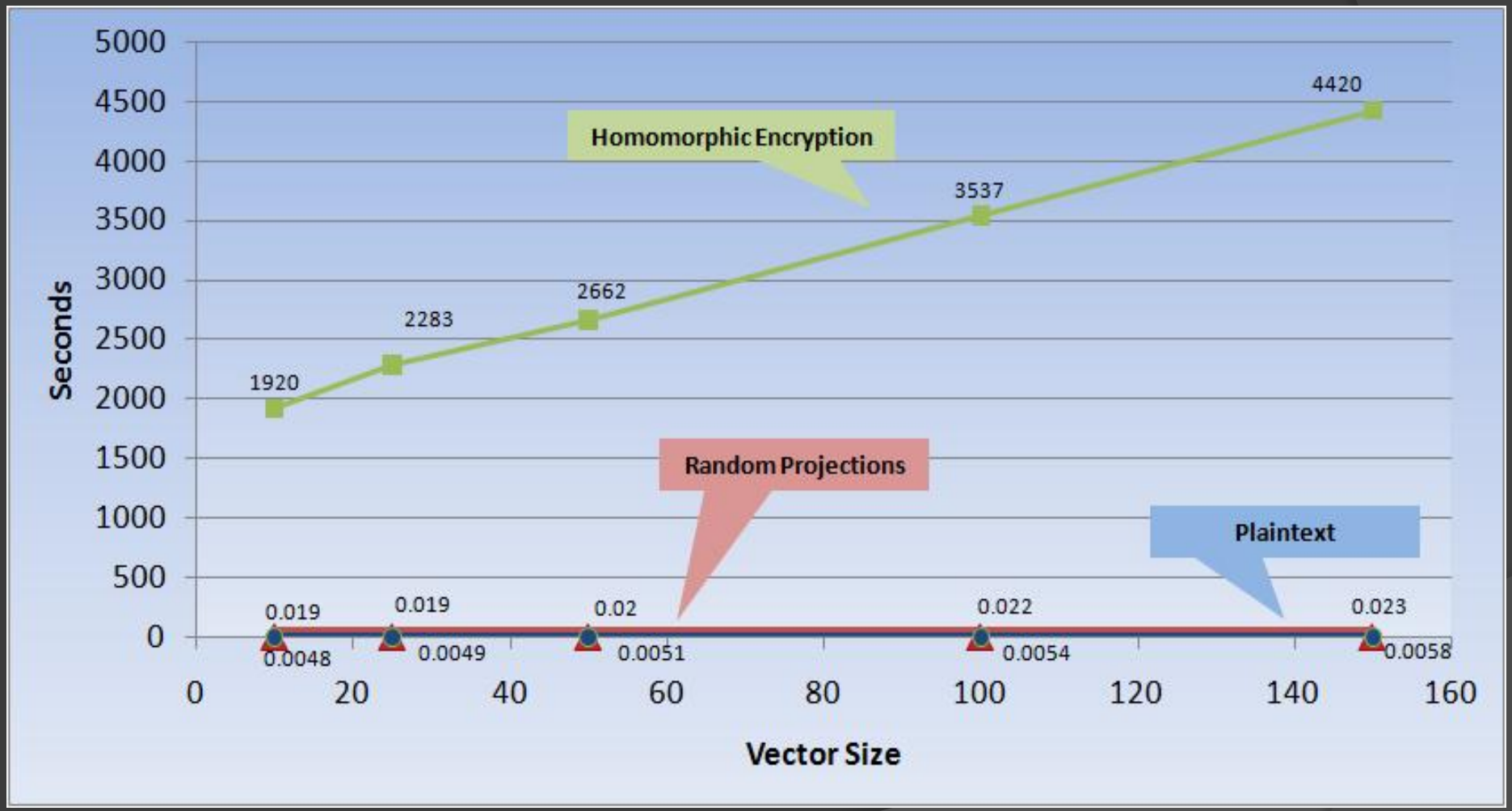
Database 200: 40 people, 5 representative variation pictures/person

RP Verification: Vector Size v. Accuracy

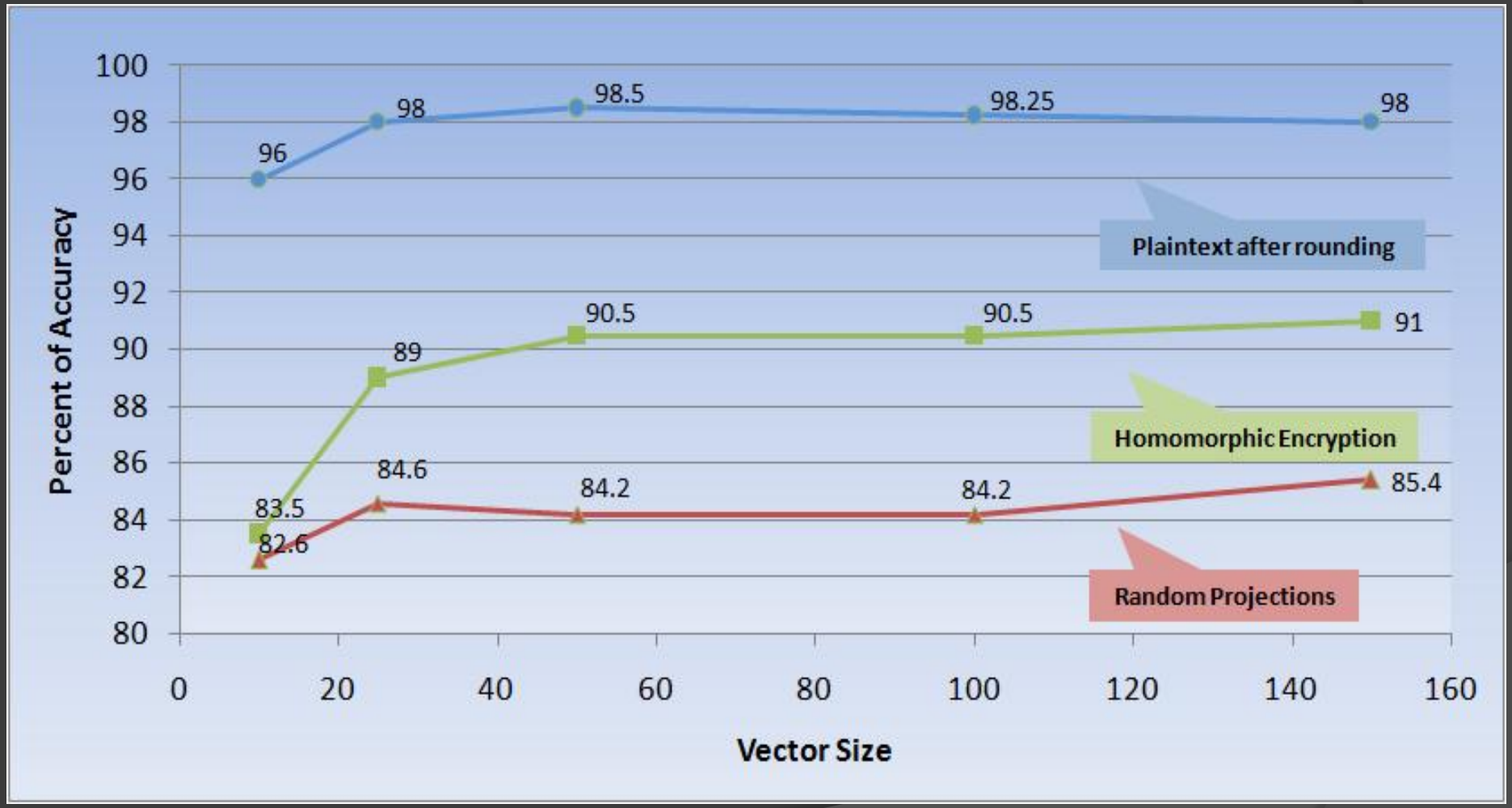


Database 200: 40 people, 5 representative variation pictures/person

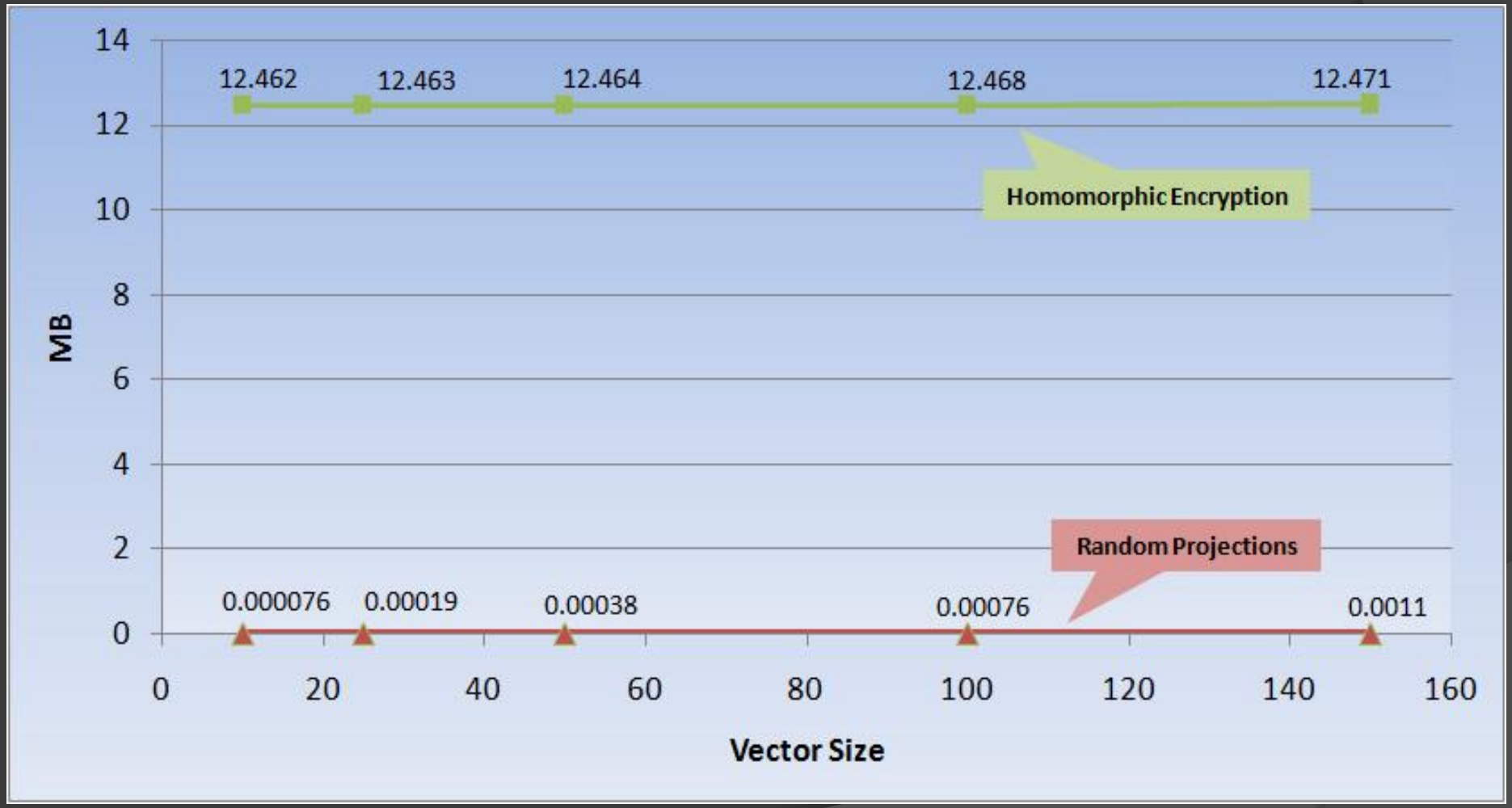
Vector Size v. Runtime



Vector Size v. Matching Accuracy



Vector Size v. Bandwidth



Conclusion & Future Work

- Homomorphic Encryption: security and accuracy
  most secure communication method, database in plaintext

- Random Projections: easy to use and fast
  communication is not as secure, database doesn't store plaintext

- Current and Future Work:
  1. Implementation & testing of Error Correction Code
  2. Implementation of Garbled Circuit – ~40% faster

Acknowledgements

- National Science Foundation OCI award #1063035
- Advising Mentor: Professor Min Wu
- Graduate Student Mentor: Wenjun Lu

Citations

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