Face Recognition I

COMP 388-002/488-002 Biometrics

Daniel Moreira

Fall 2024

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Today we will…

Get to know
Reasons to use faces for recognition.
How faces compare to fingerprints.

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Today's Attendance

Please fill out the form

https://forms.gle/eFYjMJ46W3ky1WePA

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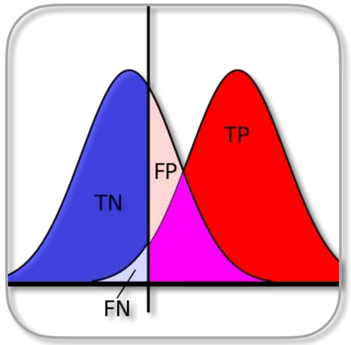
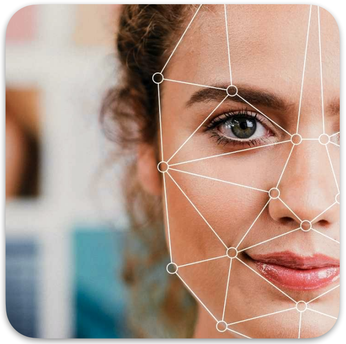
Course Overview

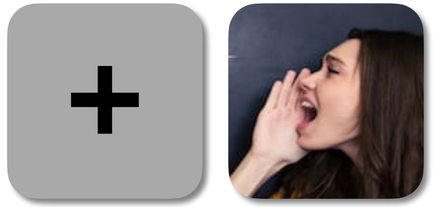
Content



Basics
Concepts
Metrics
Metric implementation



Core Traits (3)
Concepts
Baseline implementation
Data collection
Evaluation
Attacks
Assignments



Alternative Traits and Fusion
Concepts

Invited Talks (2)
State of the art
Future work

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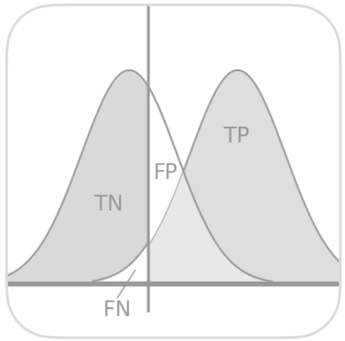
Course Overview

Content



Basics
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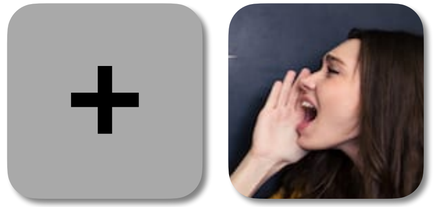

Alternative Traits and Fusion
Concepts

Invited Talks (2)
State of the art
Future work

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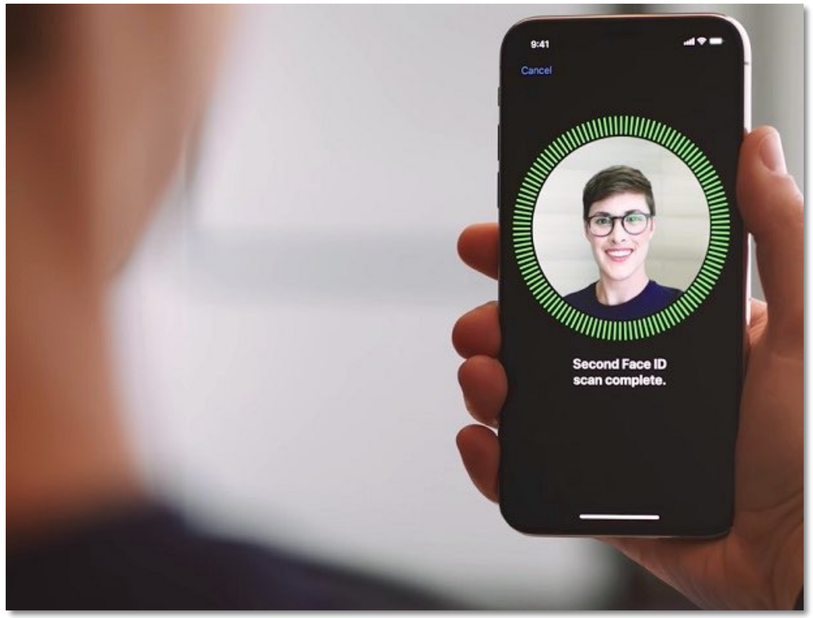
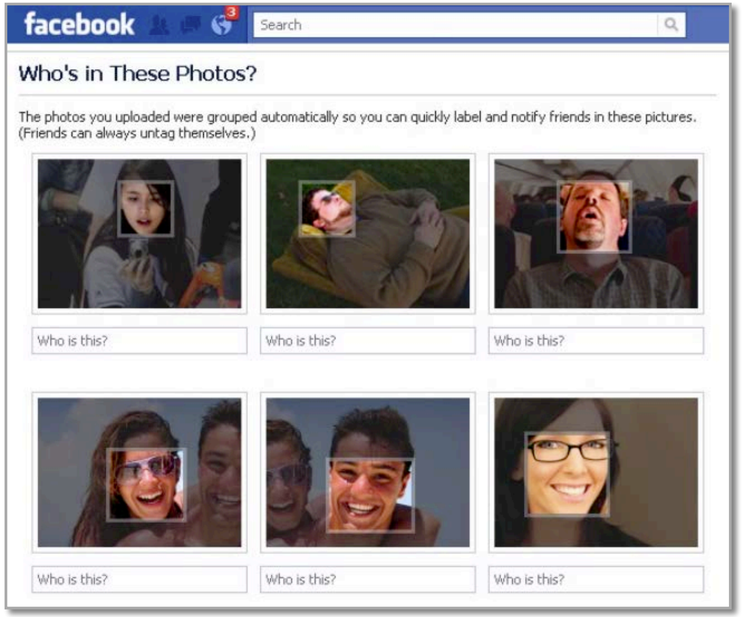
Why Faces?

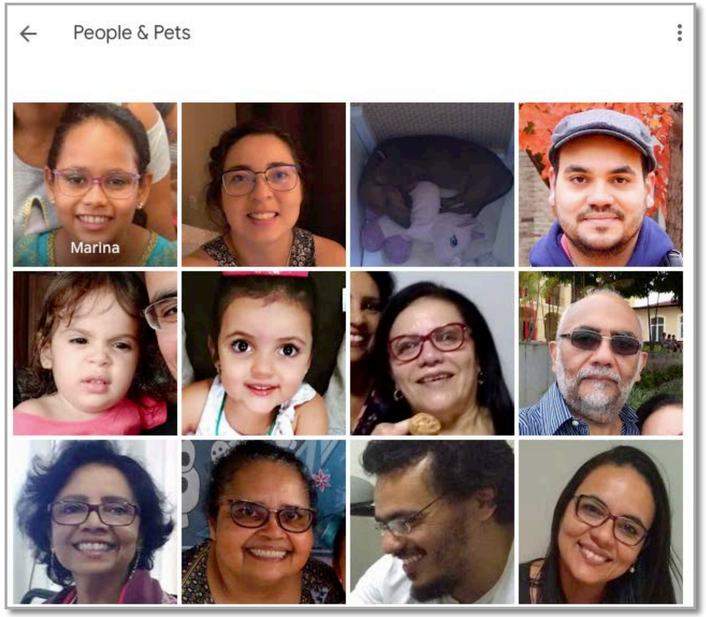
Face recognition is a reality



Personal devices



Facebook



Google Photos

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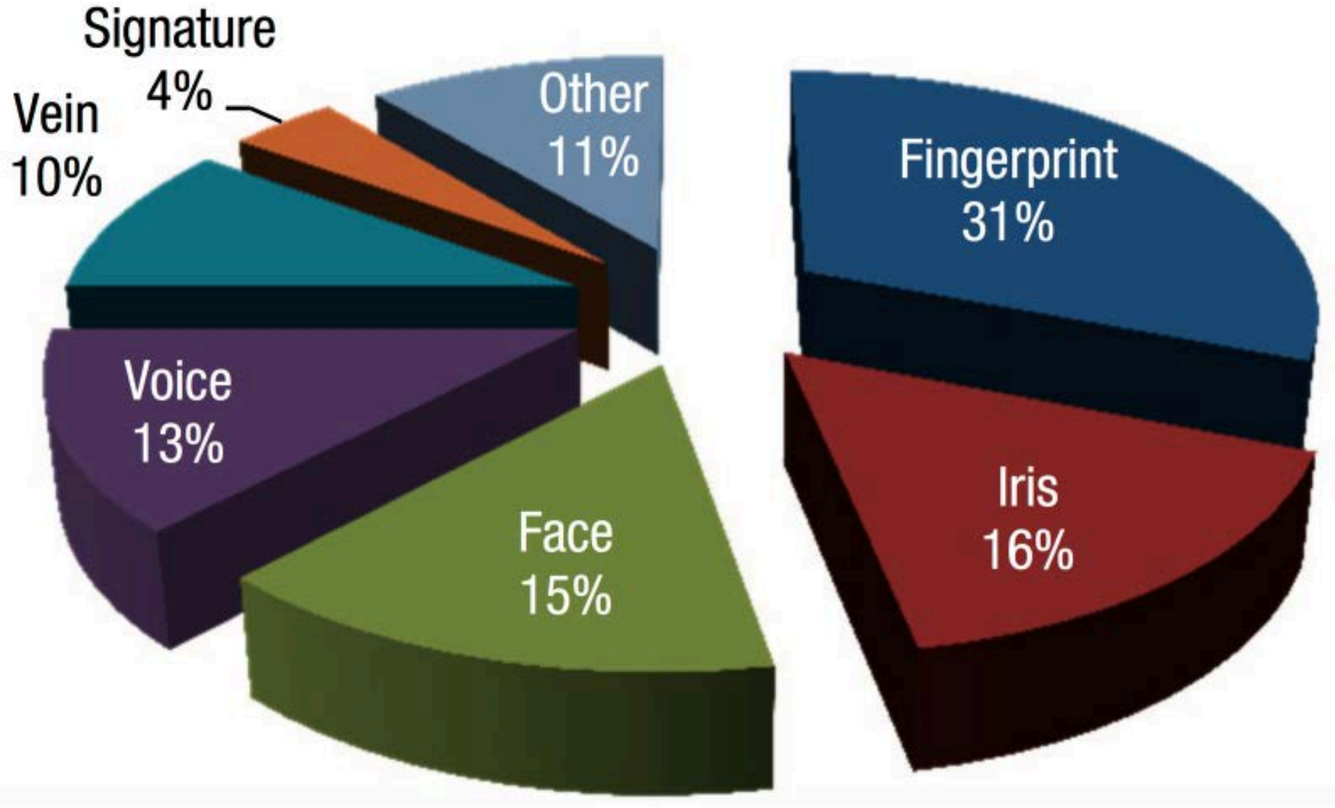
Why Faces?

Market



Source: Mani and Nadeski, *Processing solutions for biometric systems,* Texas Instruments, 2015

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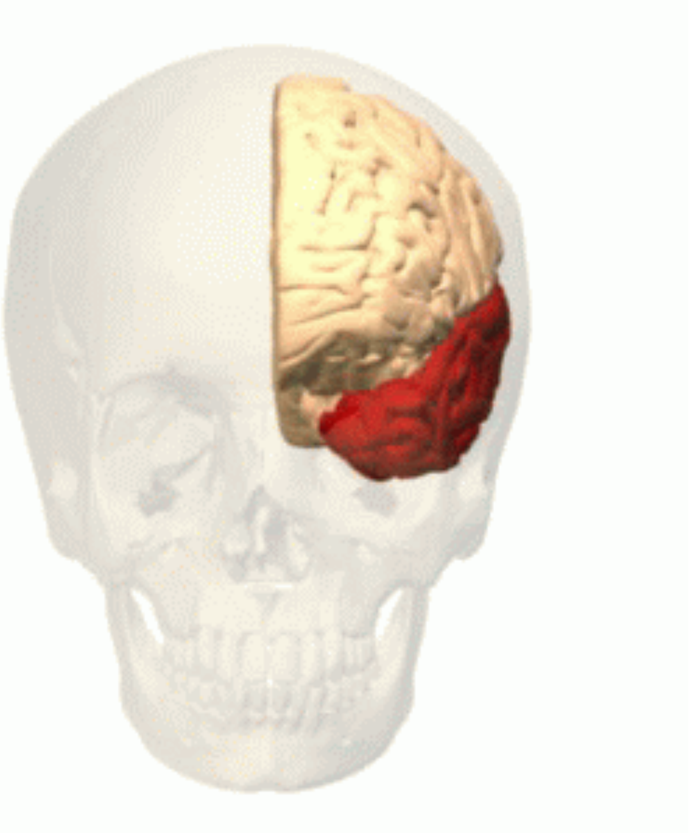
Why Faces?

Face recognition is an innate ability

Temporal cortex
Active in monkey's brains
whey they are presented with faces.

Prosopagnosia
Lost ability to recognize faces.
Affected folks can still recognize objects.



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Why Faces?

Who is she?

How different from the other one?

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Why Faces?

Who is she?

How different from the other one?

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Why Faces?

Margaret Thatcher Illusion
Peter Thompson

Who is she?

How different from the other one?

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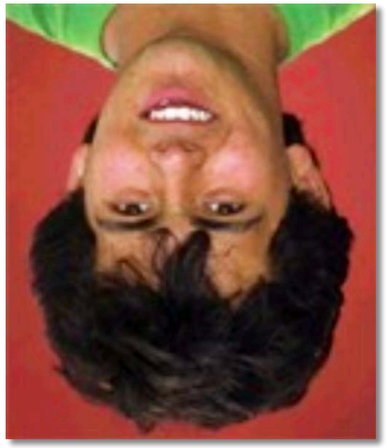
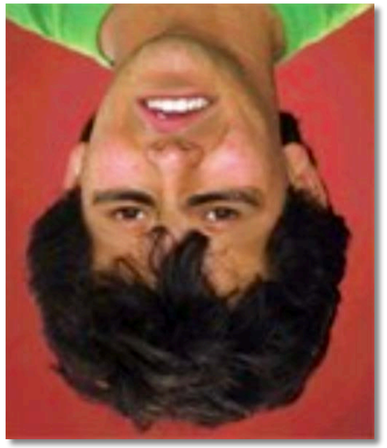
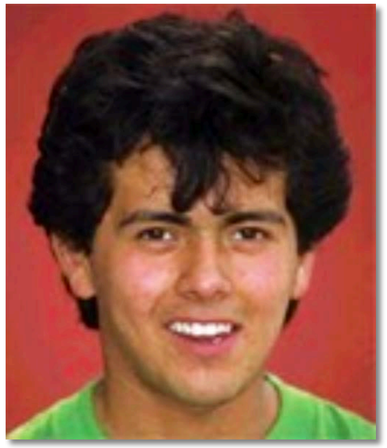
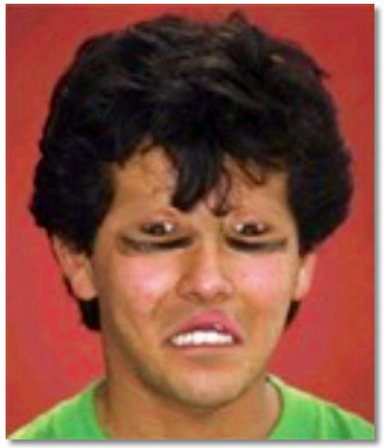
Why Faces?

https://faculty.washington.edu/chudler/java/faces.html









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Why Faces?

Face recognition is an innate ability

Facial Pareidolia
It is natural for us to perceive faces on random places.

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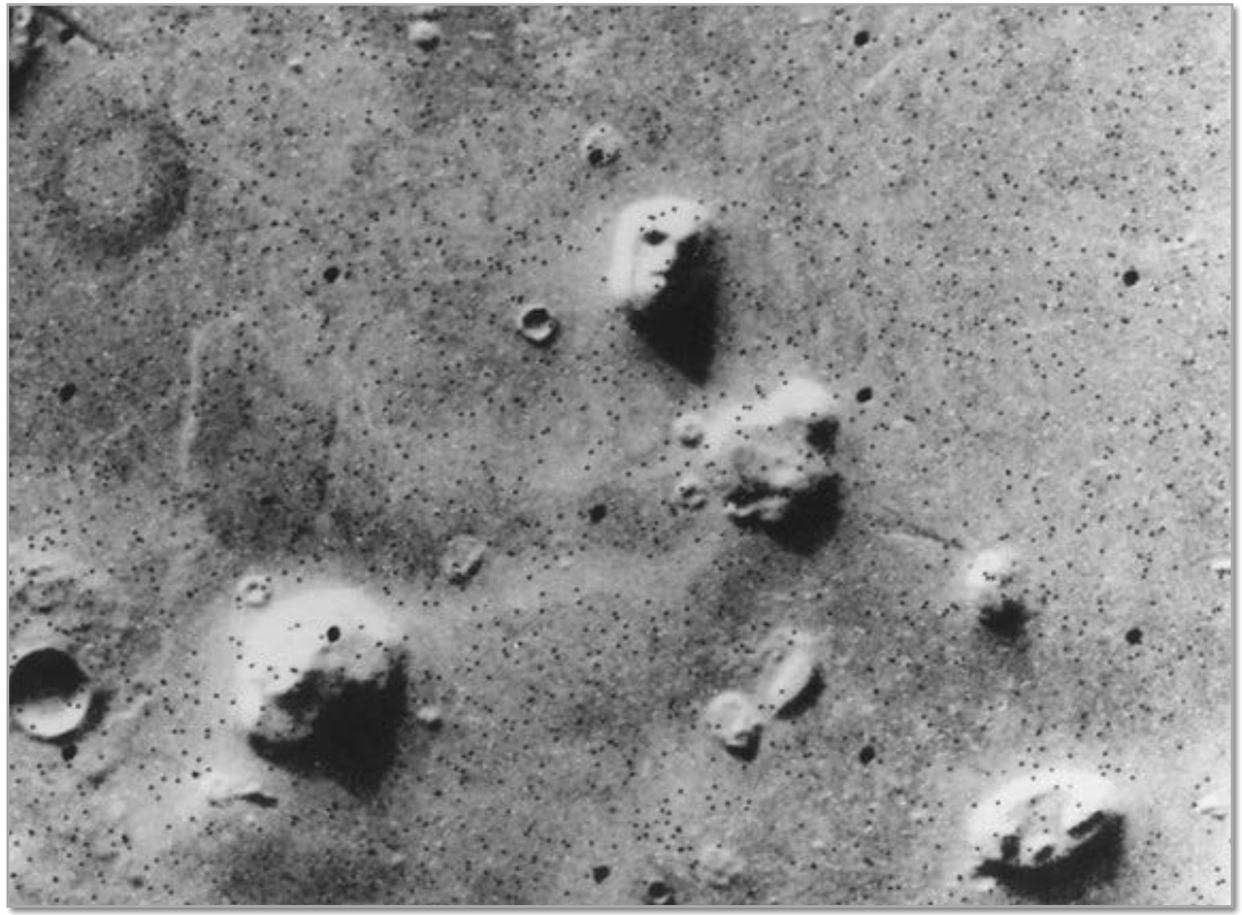
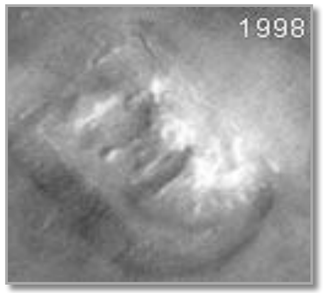
Why Faces?

Source: http://www.space.com/17191-face-on-mars.html



1976



1998

2001

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Why Faces?

Slave's Market
Salvador Dali

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Why Faces?

Slave's Market
Salvador Dali

Perceptual Rivalry

Voltaire's Bust
Jean-Antoine Houdon

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Why Faces?

The Fruit Basket
Giuseppe Arcimboldo

The Gardener
Giuseppe Arcimboldo

Perceptual Rivalry

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Why Faces?

The Fruit Basket
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Perceptual Rivalry

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Fingerprints vs. Faces

How do they compare?

https://bit.ly/45lZPUo

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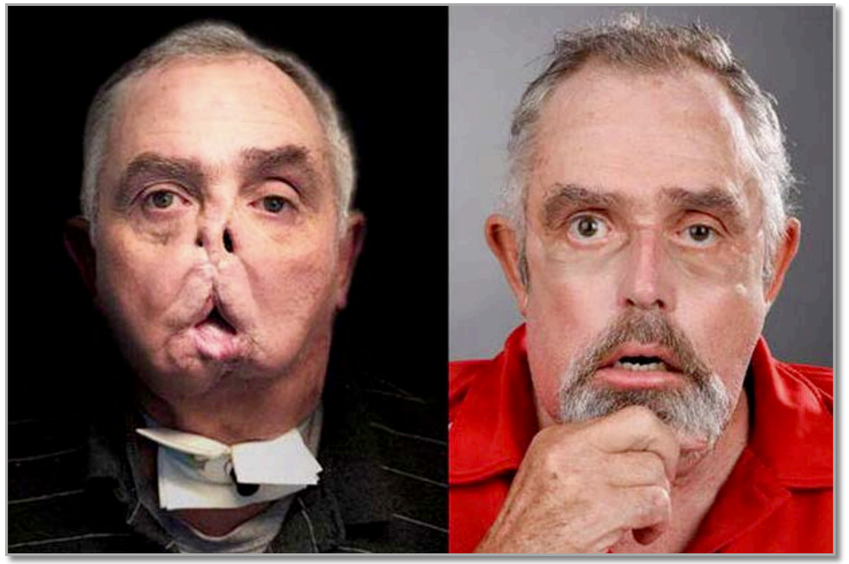
Fingerprints vs. Faces

Universality (1/8)
Does everybody have the trait?

https://www.smithsonianmag.com/science-nature/adermatoglyphia-genetic-disorder-people-born-without-fingerprints-180949338/

Adermatoglyphia

https://www.cbsnews.com/pictures/amazing-face-transplants-graphic-images/



Face transplants

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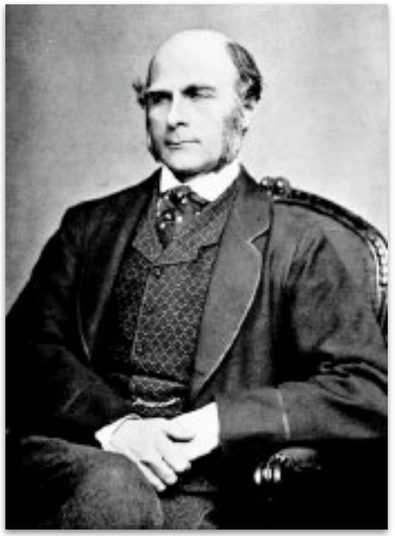
Fingerprints vs. Faces

Uniqueness (2/8)
How likely two or more individuals will present the same trait?

Source: John Daugman Lecture Notes, 2018



Galton's probability of 2 people presenting the same fingerprint: 1 in 64 billion.

Identical twins.

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Identical Twins?

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Source: John Daugman
Lecture Notes, 2018

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Source: http://lubbockonline.com/slideshows/051108/277846477/slide4.shtml

Mother and daughter.

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Identical Twins?

Source: John Daugman
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Lecture Notes, 2018

Source: http://lubbockonline.com/slideshows/051108/277846477/slide4.shtml

Source: John Daugman
Lecture Notes, 2018

Mother and daughter.

Unrelated.

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Completely unrelated subjects.

Source: John Daugman Lecture Notes, 2018

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Fingerprints vs. Faces

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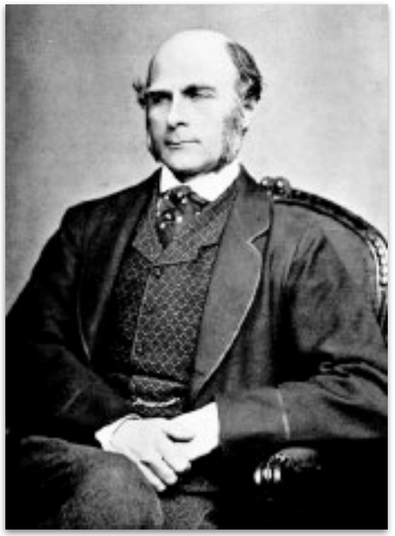

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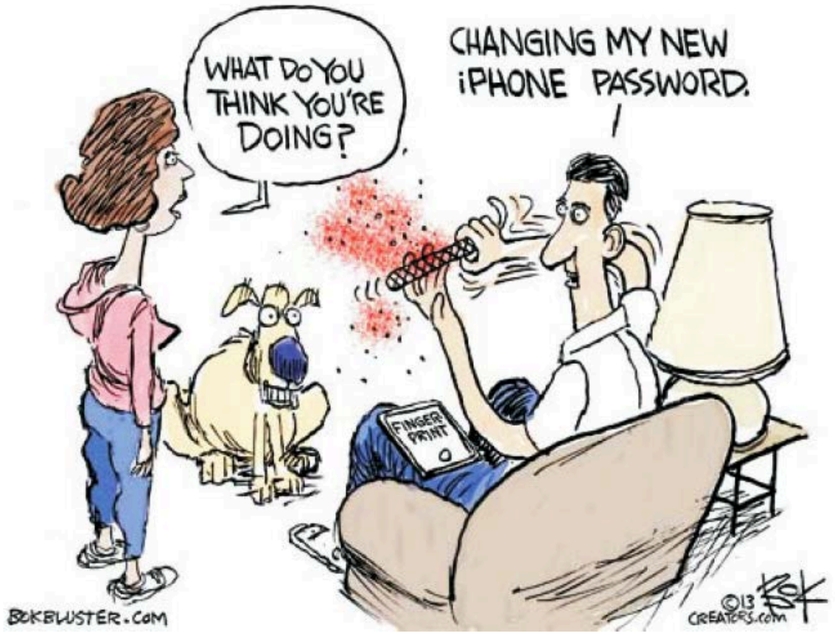
Fingerprints vs. Faces

Permanence (3/8)
How easily does the trait change?



You cannot easily change your fingerprints.

But your face **will** change.

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Fingerprints vs. Faces

Permanence (3/8)
How easily does the trait change?

Aging

Source: Lantinis
A survey of the effects of aging on biometric identity verification
International Journal of Biometrics 2(1), 2010

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Fingerprints vs. Faces

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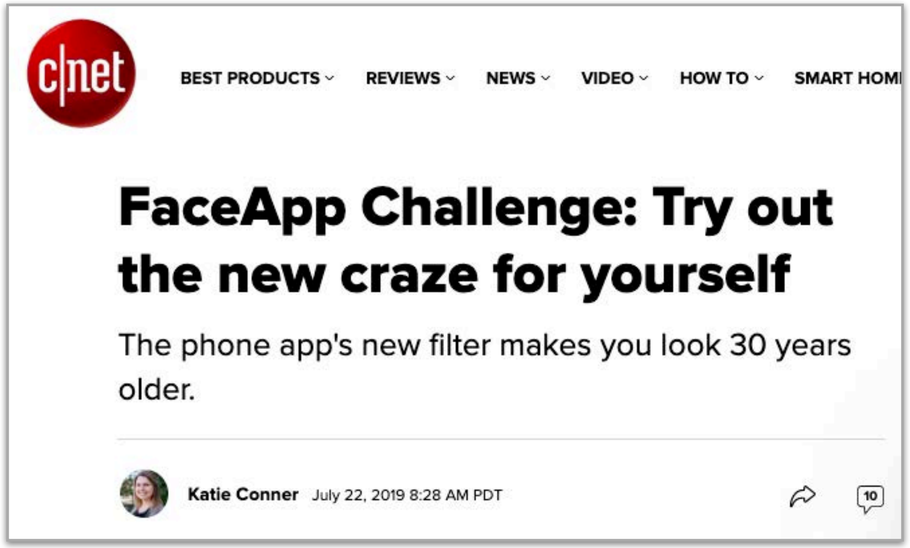
Fingerprints vs. Faces

Permanence (3/8)
How easily does the trait change?

Aging
Will it always be a challenge?



https://www.cnet.com/how-to/faceapp-challenge-try-out-the-new-craze-for-yourself/

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Fingerprints vs. Faces

Permanence (3/8)
How easily does the trait change?

Aging
Will it be useful?

Madeleine McCann

5 years (real)

9 years (simulated)

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Fingerprints vs. Faces

Permanence (3/8)
How easily does the trait change?

Deliberate Changes

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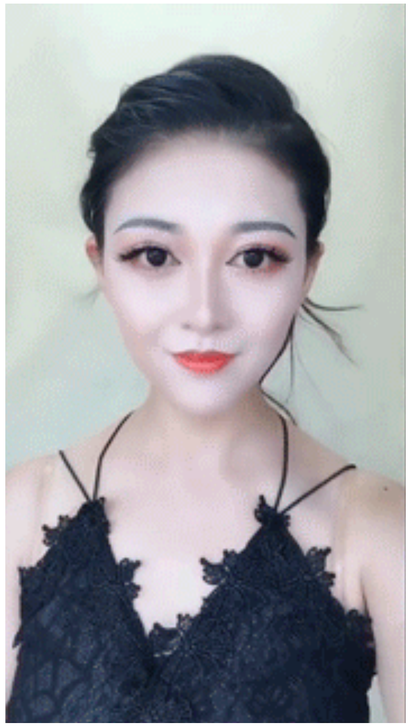
Fingerprints vs. Faces

Permanence (3/8)
How easily does the trait change?

Deliberate Changes

https://www.youtube.com/watch?v=Z4nc6OYY3no



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Fingerprints vs. Faces

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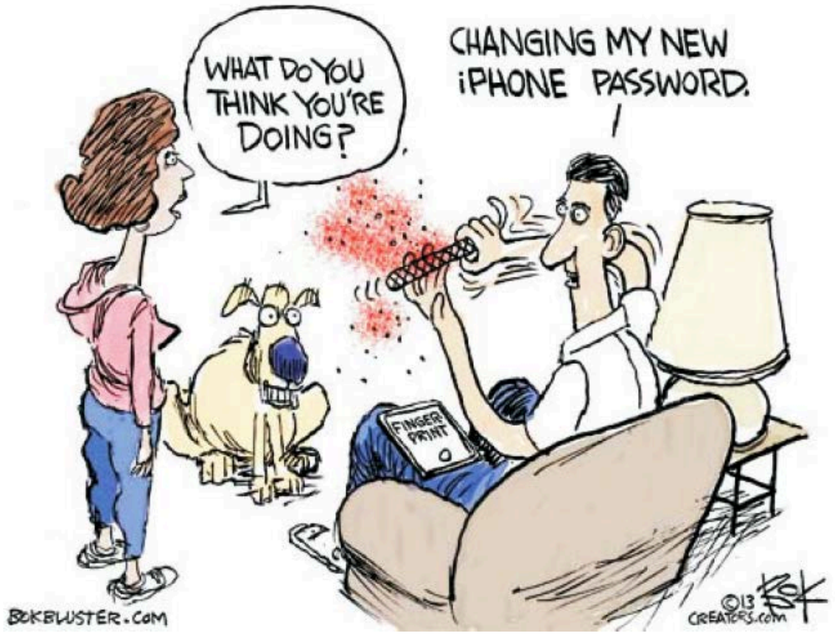

You cannot easily change your fingerprints.

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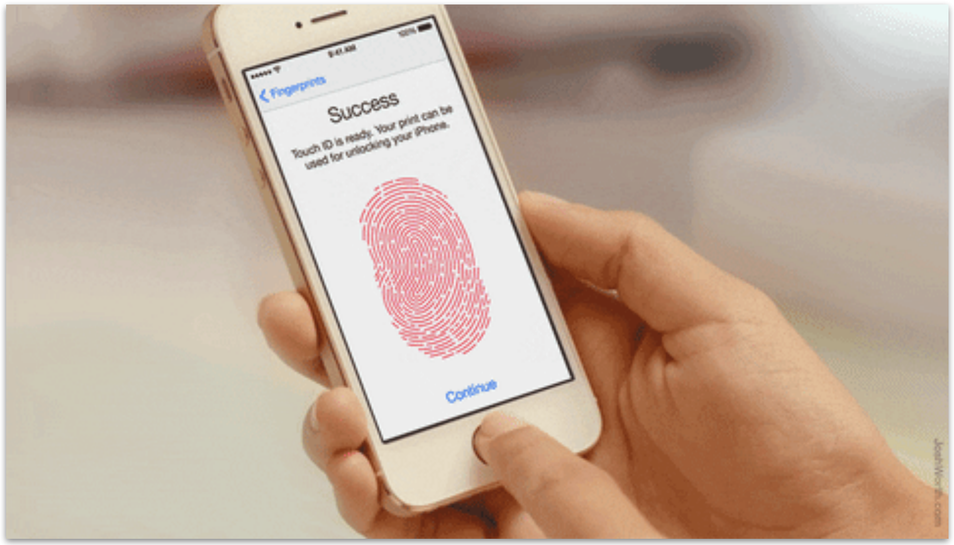
Fingerprints vs. Faces

Measurability (4/8)
How easy is it to acquire and digitize the trait?



https://www.youtube.com/watch?v=uQHqZNyXoBQ

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Fingerprints vs. Faces

Measurability (4/8)
How easy is it to acquire and digitize the trait?

Unconstrained Acquisition

https://www.nist.gov/system/files/documents/itl/iad/ig/05771424.pdf

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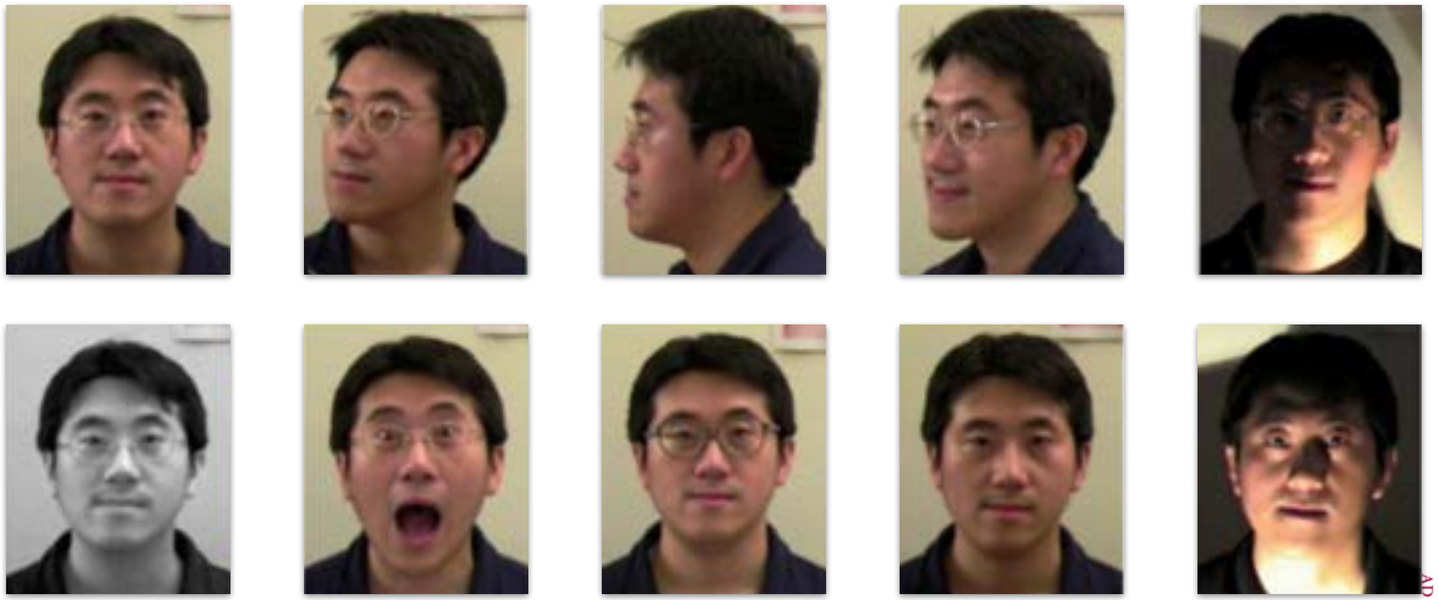
Fingerprints vs. Faces

Measurability (4/8)
How easy is it to acquire and digitize the trait?

Large Intra-Class Variation
Different pose, illumination, expression, accessories (e.g.. glasses), resolution.



Hsu
Face detection and modeling for recognition
PhD Thesis, MSU, 2002.

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Fingerprints vs. Faces 🏆

Acceptability (5/8)
Will individuals collaborate during data collection?

https://www.youtube.com/watch?v=Qt79QAwgi80

https://www.youtube.com/watch?v=BYN4oF_bi4c

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Fingerprints vs. Faces

Acceptability (5/8)
Will individuals collaborate during data collection?

Privacy Concerns

Robert Downey Jr.

Scarlet Johansson

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Fingerprints vs. Faces

Acceptability (5/8)
Will individuals collaborate during data collection?

Privacy Concerns

Latent Fingerprint

Whose latent fingerprint is this?
Robert's or Scarlet's?

Is it the fingerprint of a man or woman?
Is it the fingerprint of a younger or older person?

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Fingerprints vs. Faces

Acceptability (5/8)
Will individuals collaborate during data collection?

Privacy Concerns

“Latent Face”

Whose face is this?
Robert's or Scarlet's?

No way it is Scarlet’s. This is a man.
No way it is Robert. This is an older man.

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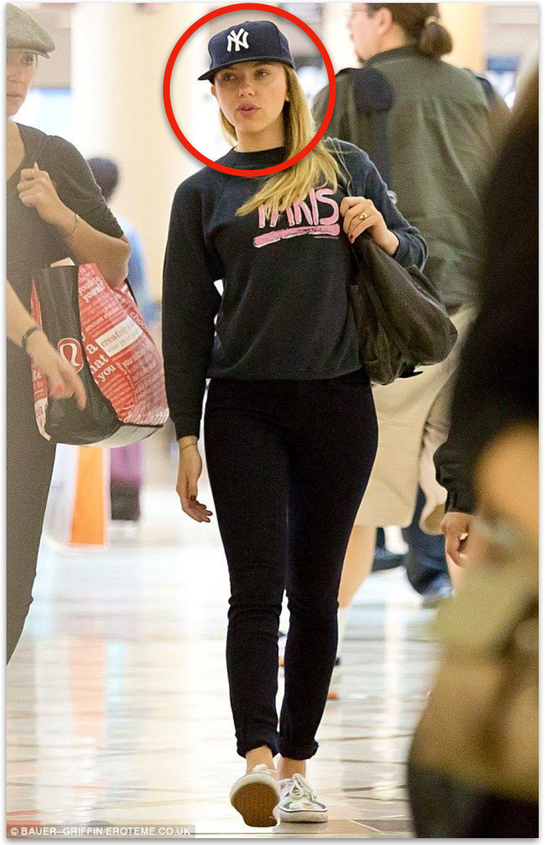
Fingerprints vs. Faces

Acceptability (5/8)
Will individuals collaborate during data collection?

Privacy Concerns
Which trait helps to recognize Scarlet quicker?

Latent Fingerprint



“Latent Face”

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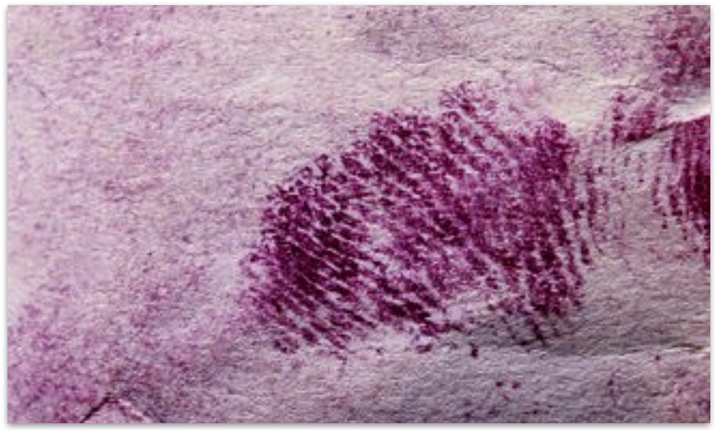
Fingerprints vs. Faces

Acceptability (5/8)
Will individuals collaborate during data collection?

Privacy Concerns
Which trait favors **covert deployment**?



Latent Fingerprint

“Latent Face”

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Fingerprints vs. Faces 🏆

Circumvention (6/8)
How easy can the trait be forged or imitated?

https://www.youtube.com/watch?v=KdycMYILTr0

We are not there yet!

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Fingerprints vs. Faces

Circumvention (6/8)
How easy can the trait be forged or imitated?

Limitations

https://www.wired.com/story/10-year-old-face-id-unlocks-mothers-iphone-x/

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Fingerprints vs. Faces

Circumvention (6/8)
How easy can the trait be forged or imitated?

Attacks
Presentation Attack.

https://www.youtube.com/watch?v=BGgQ9woZQOg

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Fingerprints vs. Faces

Explainability (7/8)
How easy is it for the everyman to understand the trait comparison?

Same fingerprint?

You need to know fingerprint features.

Everybody is an expert
in face recognition.

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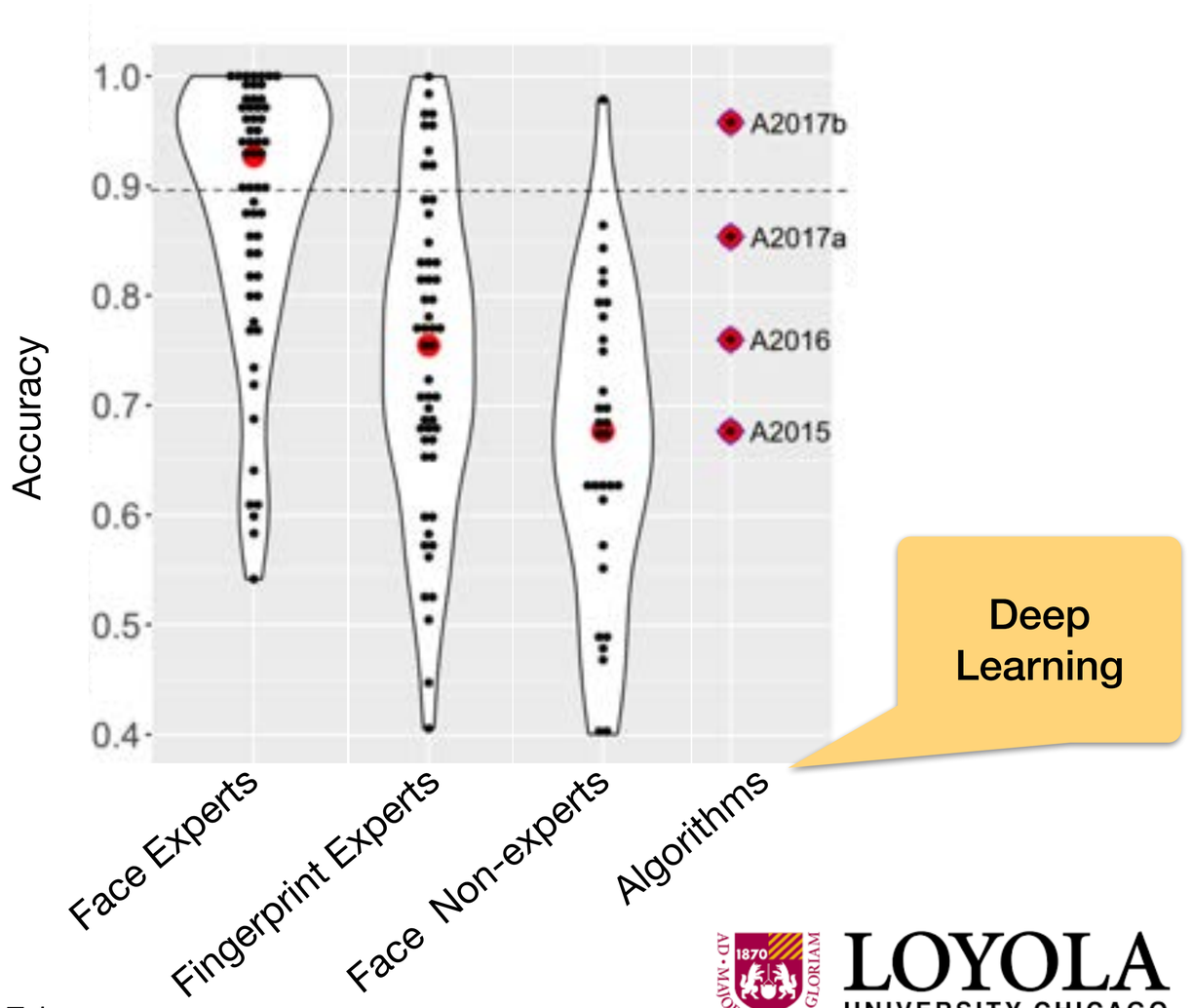
Fingerprints vs. Faces

Performance (8/8)
How good is the trait quantitatively according to objective metrics?

Face Recognition Improvement
Methods are improving quickly.
Benefits from deep learning.

Publication
Phillips et al.
Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms.
PNAS, 2018



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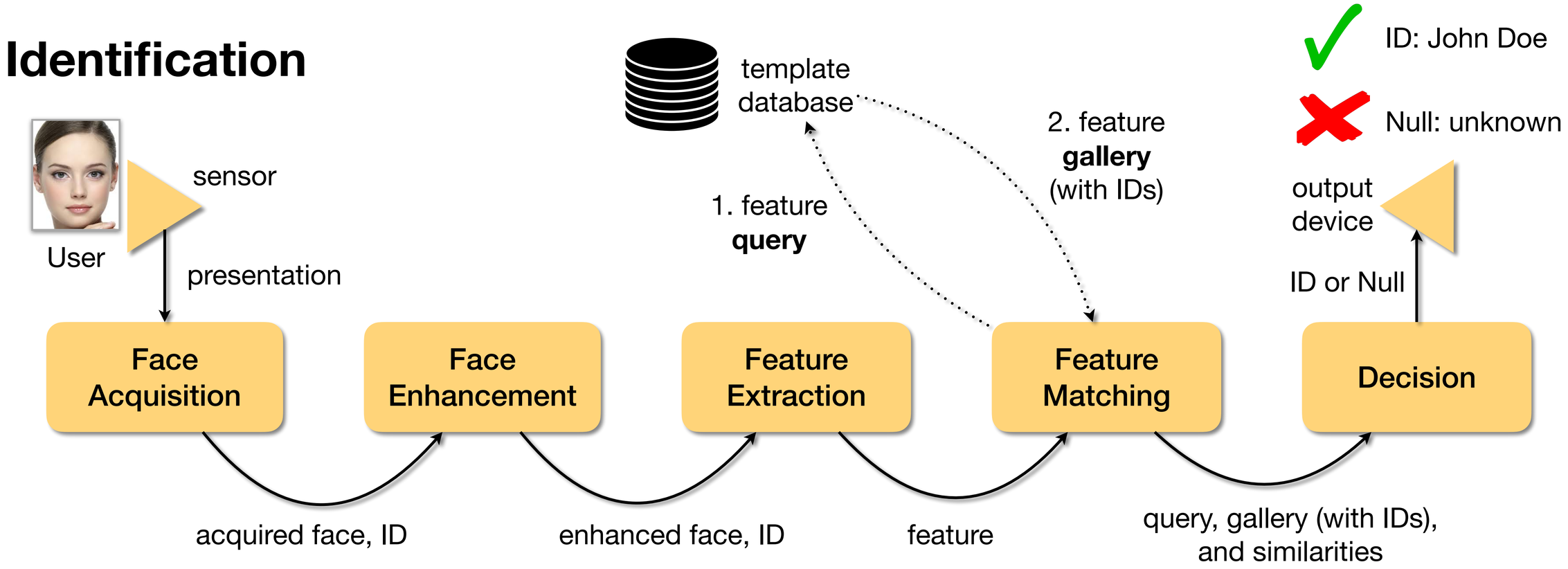
Face Recognition



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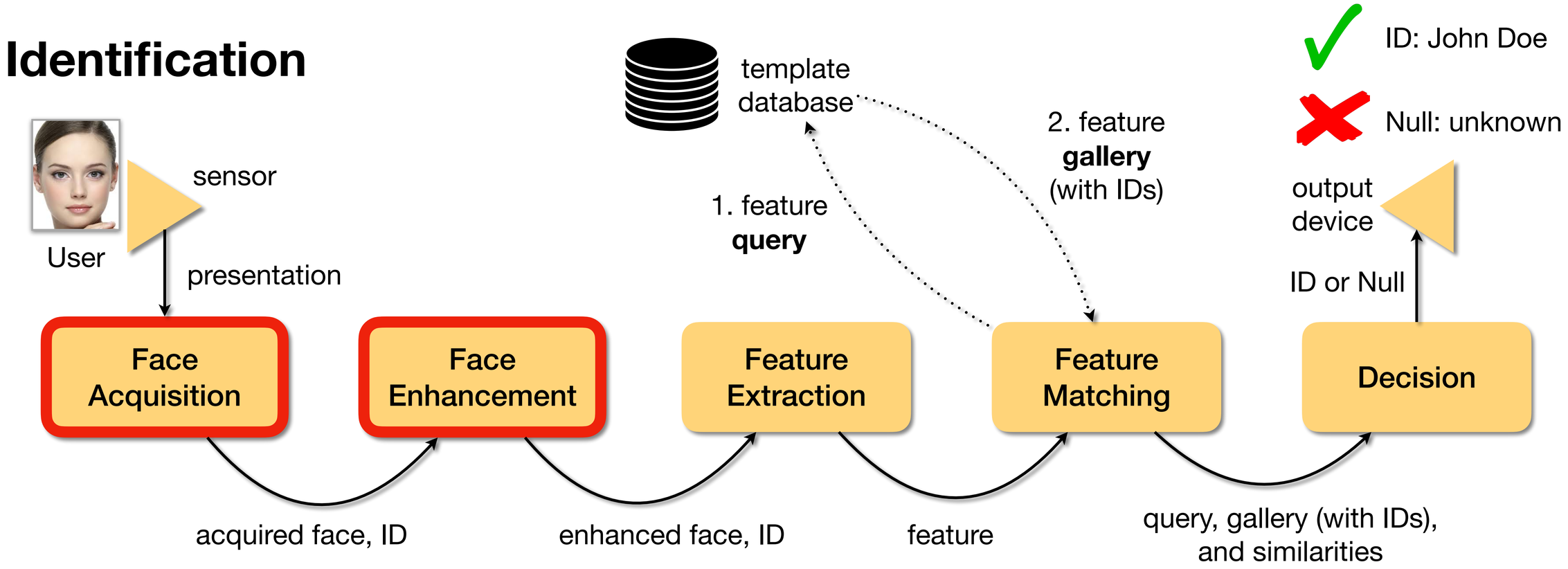
Face Recognition



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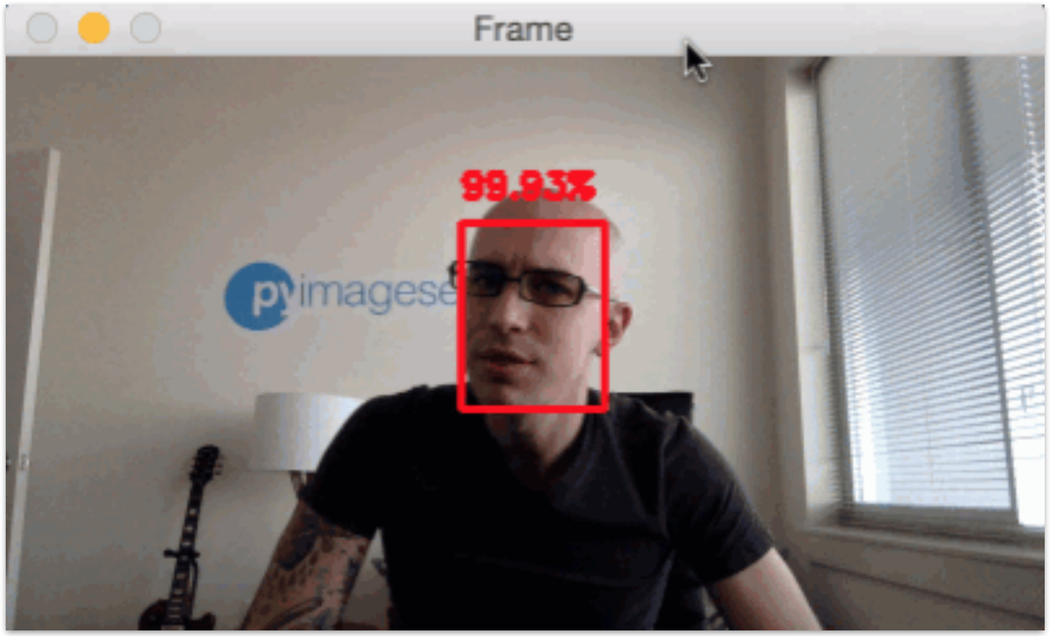
What's Next?

Face Recognition Pipeline
Face acquisition and
face detection/localization.

Fill out your
***Today-I-missed* Statement**
Please visit
https://sakai.luc.edu/x/HAZC1P.



http://insidenothing.blogspot.com/2018/02/face-detection-with-opencv-and-deep.html

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