

Face Recognition I

COMP 388-002/488-002 Biometrics

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Fall 2025



LOYOLA
UNIVERSITY CHICAGO

Today we will...

Get to know

Reasons to use faces for recognition.

How faces compare to fingerprints.

Today's Attendance

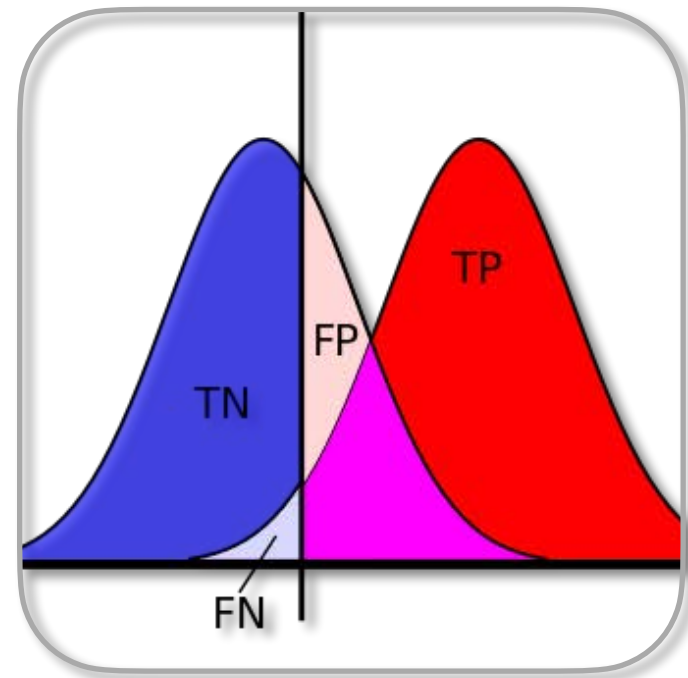
Please fill out the form

forms.gle/n5gAWHV9NzWooYDf8



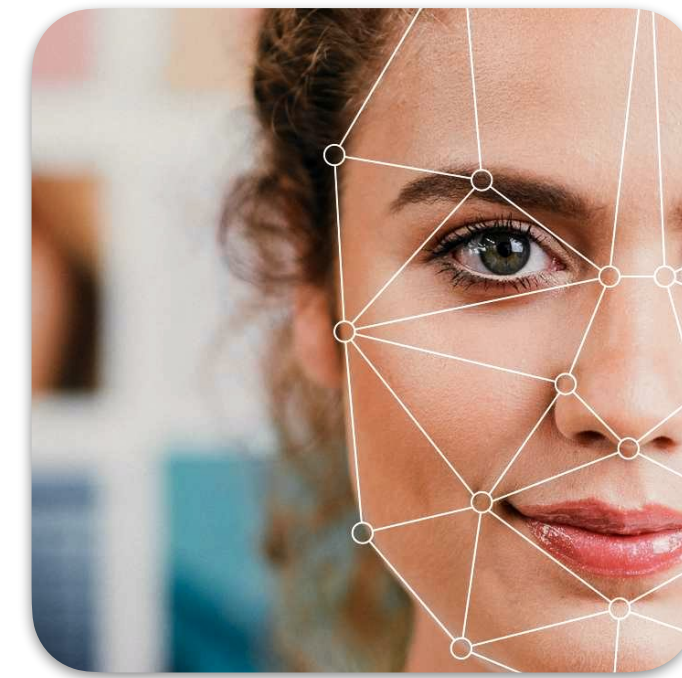
Course Overview

Content



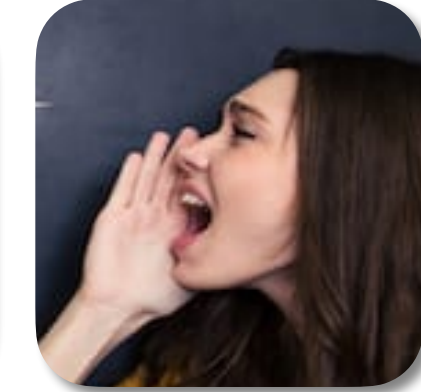
Basics

Concepts
Metrics
Metric
implementation



Core Traits (3)

Concepts
Baseline implementation
Data collection
Evaluation
Attacks
Assignments



**Alternative Traits and
Fusion
Concepts**



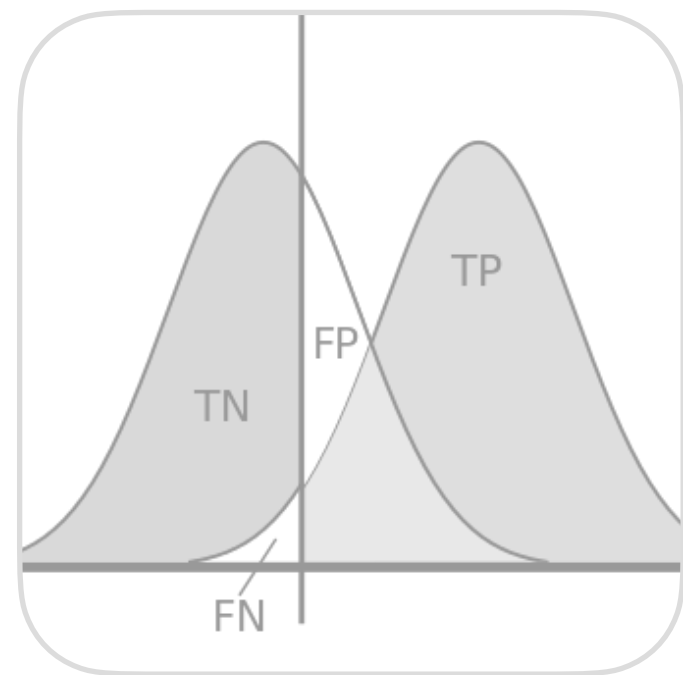
Invited Talks (2)
State of the art
Future work



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Course Overview

Content



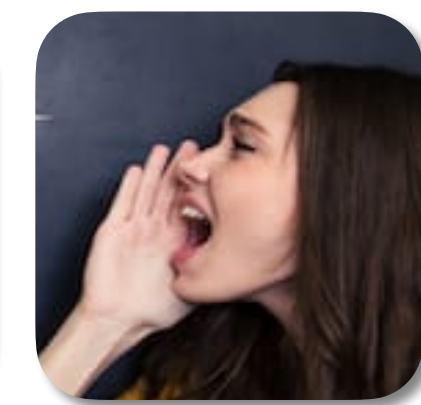
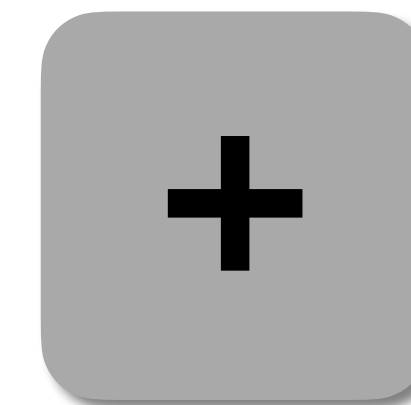
Basics

Concepts
Metrics
Metric
implementation



Core Traits (3)

Concepts
Baseline implementation
Data collection
Evaluation
Attacks
Assignments



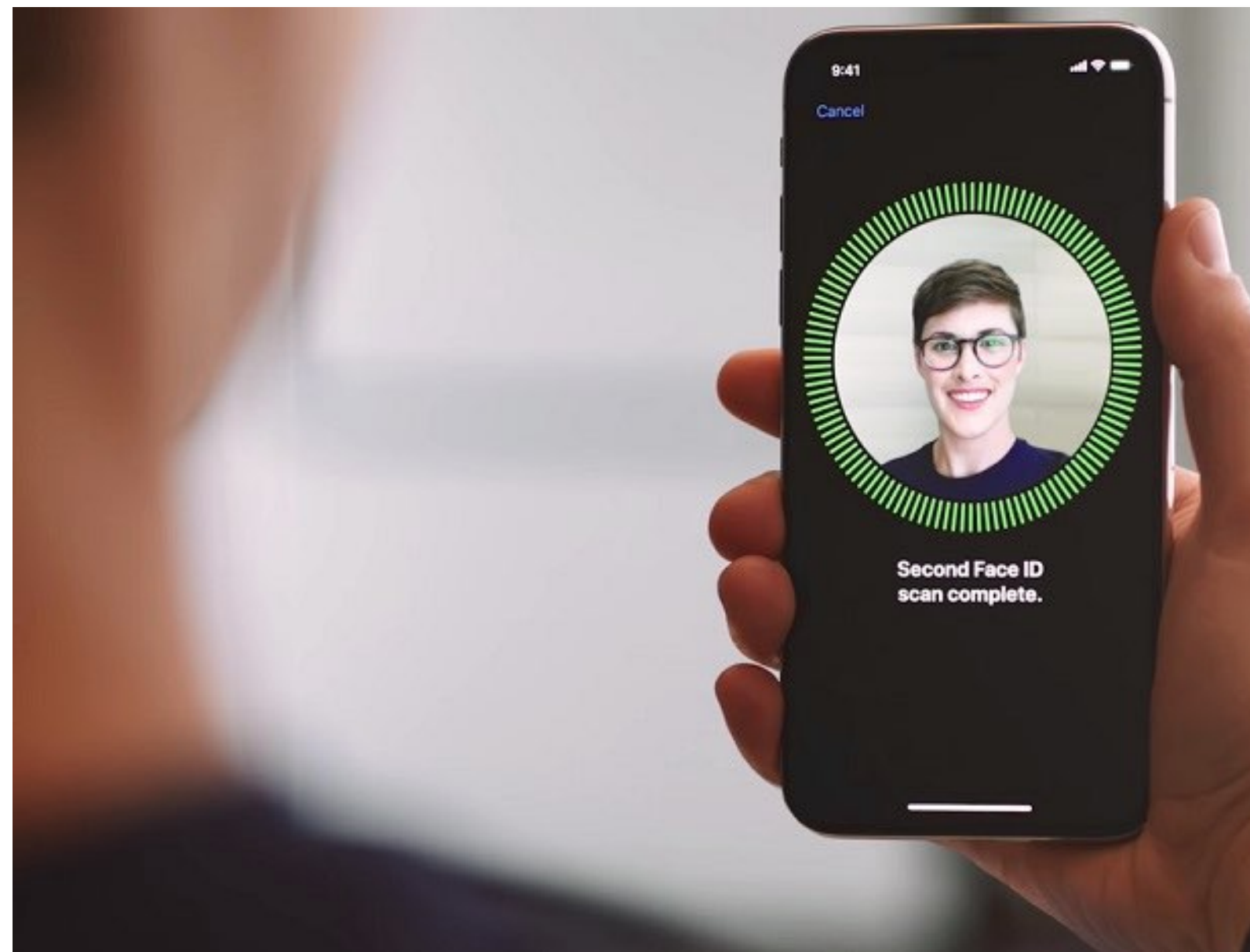
Alternative Traits and Fusion
Concepts



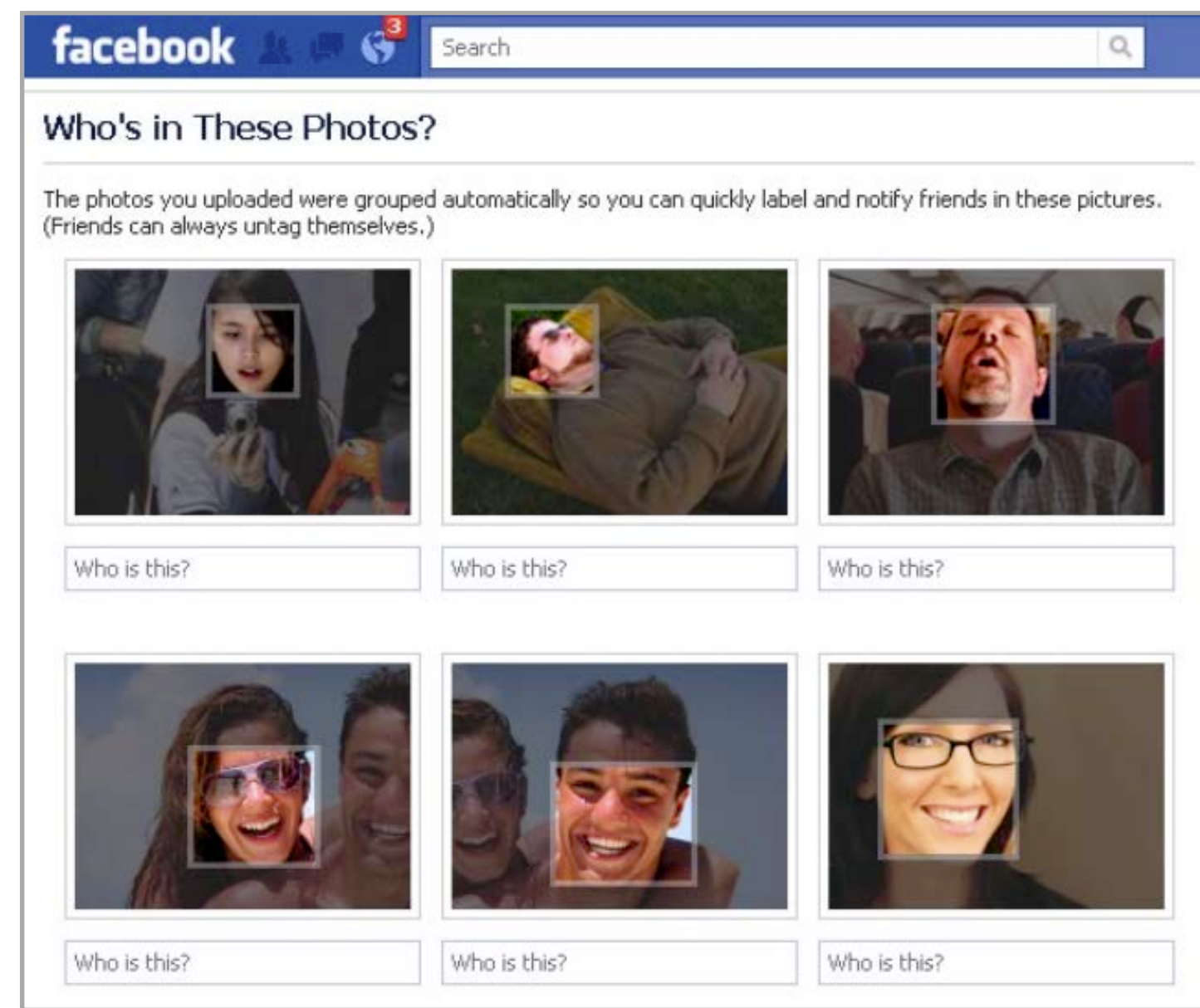
Invited Talks (2)
State of the art
Future work

Why Faces?

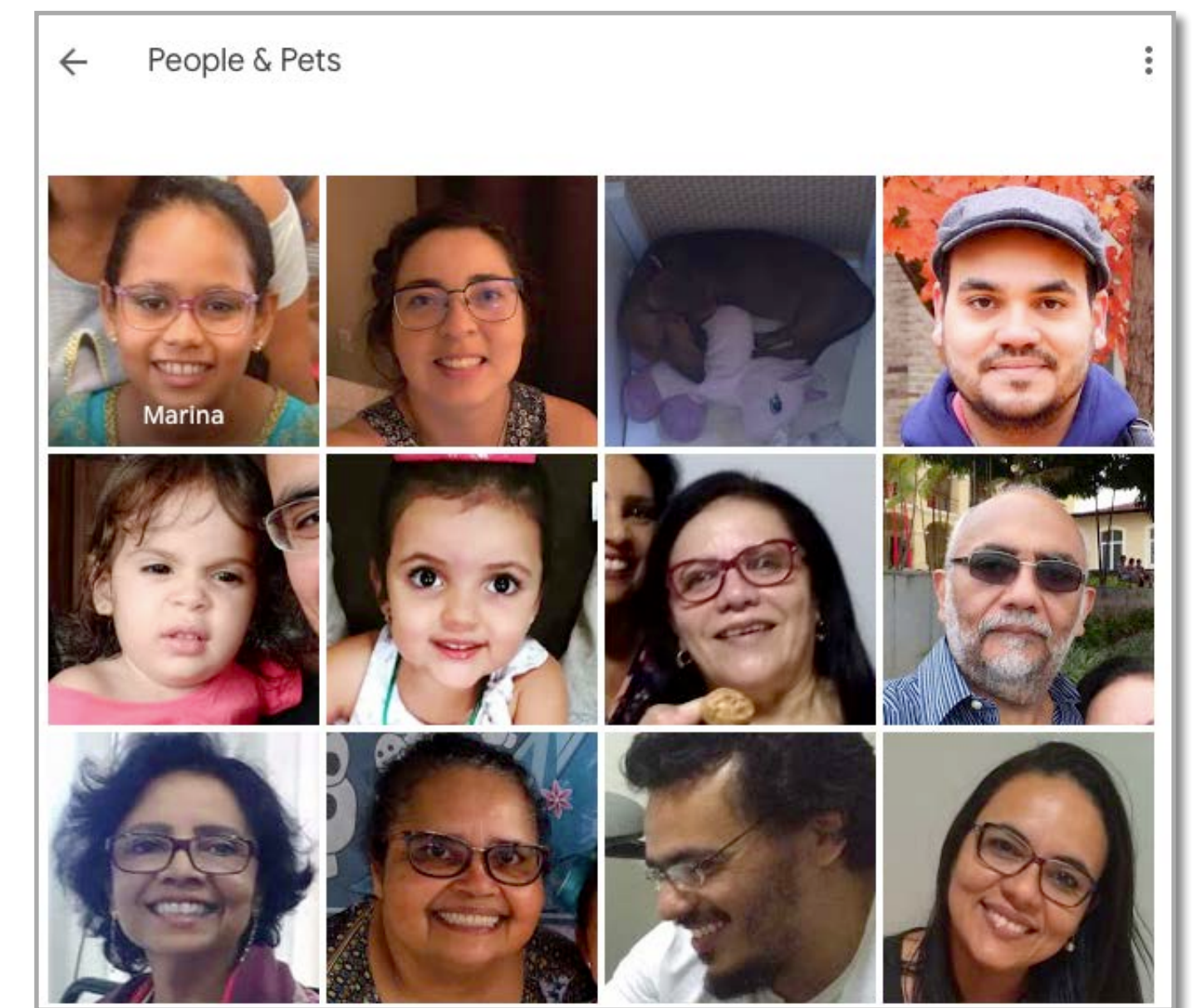
Face recognition is a reality



Personal devices



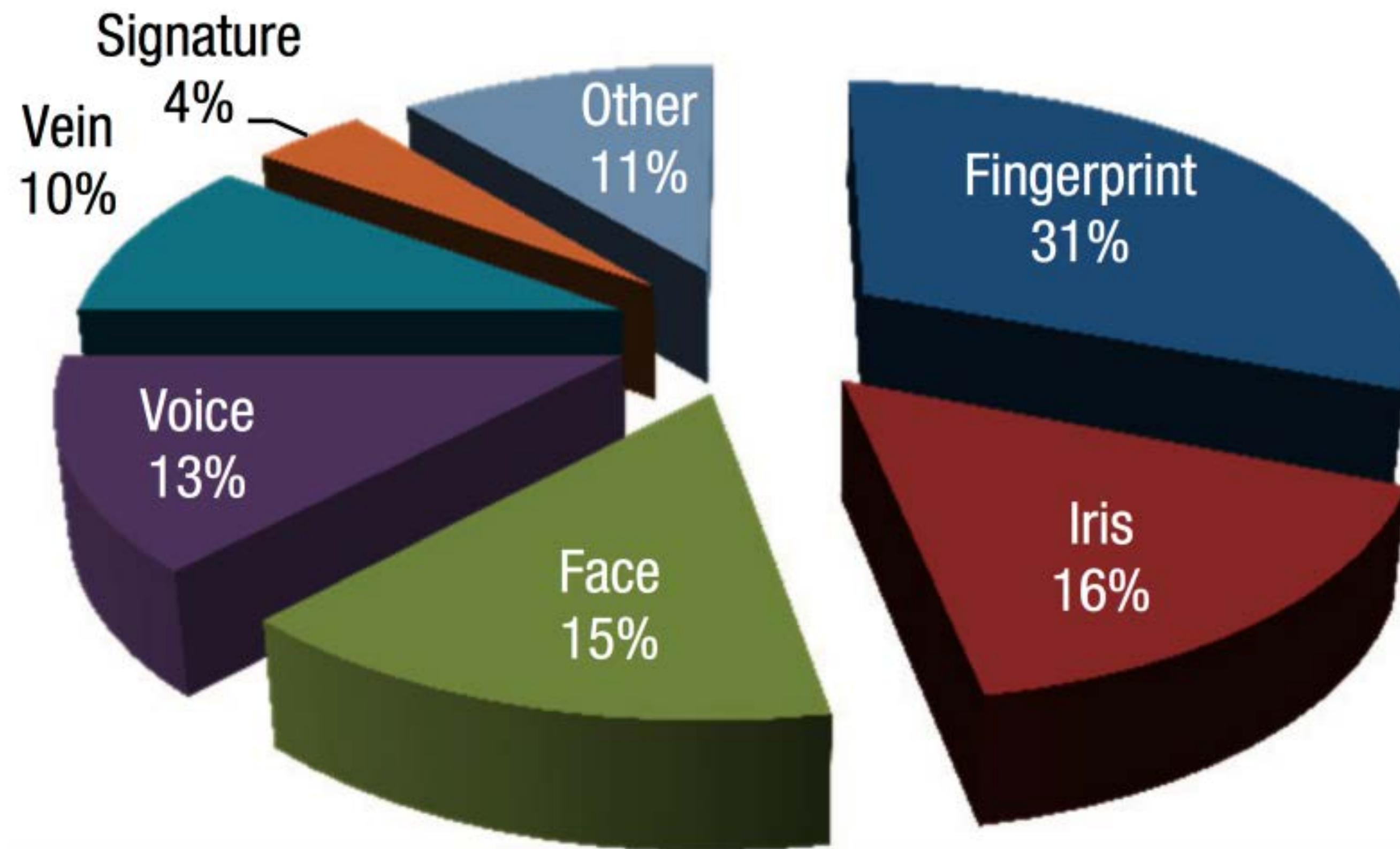
Facebook



Google Photos

Why Faces?

Market



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

Why Faces?

Face recognition is an innate ability

Temporal cortex

Active in monkey's brains
when they are presented with faces.

Prosopagnosia

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



Why Faces?



Who is she?



How different from
the other one?

Why Faces?



Who is she?



How different from
the other one?

Why Faces?

Margaret Thatcher Illusion
Peter Thompson

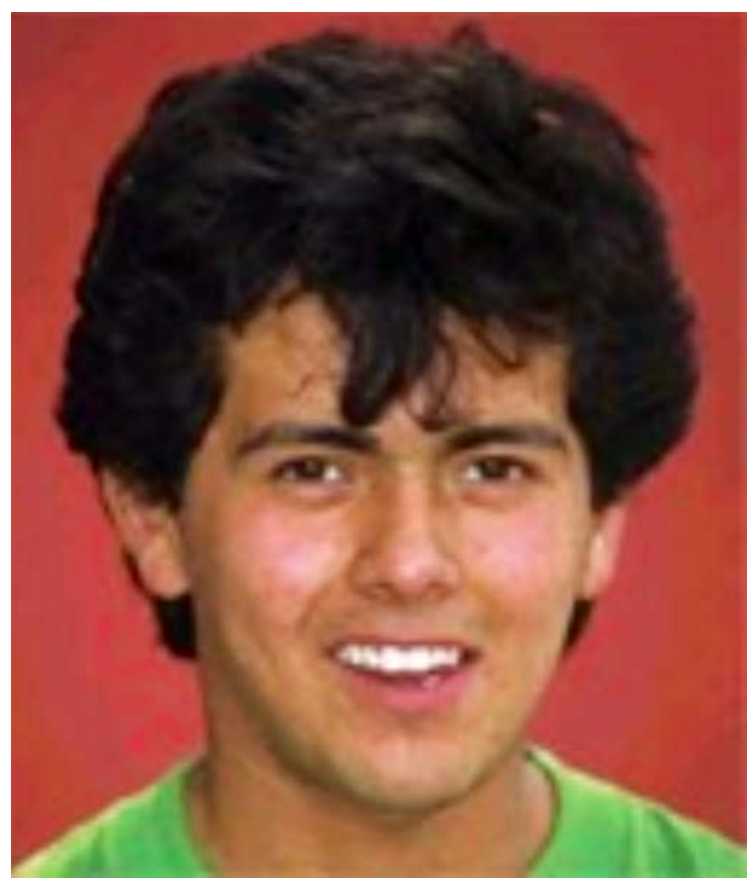
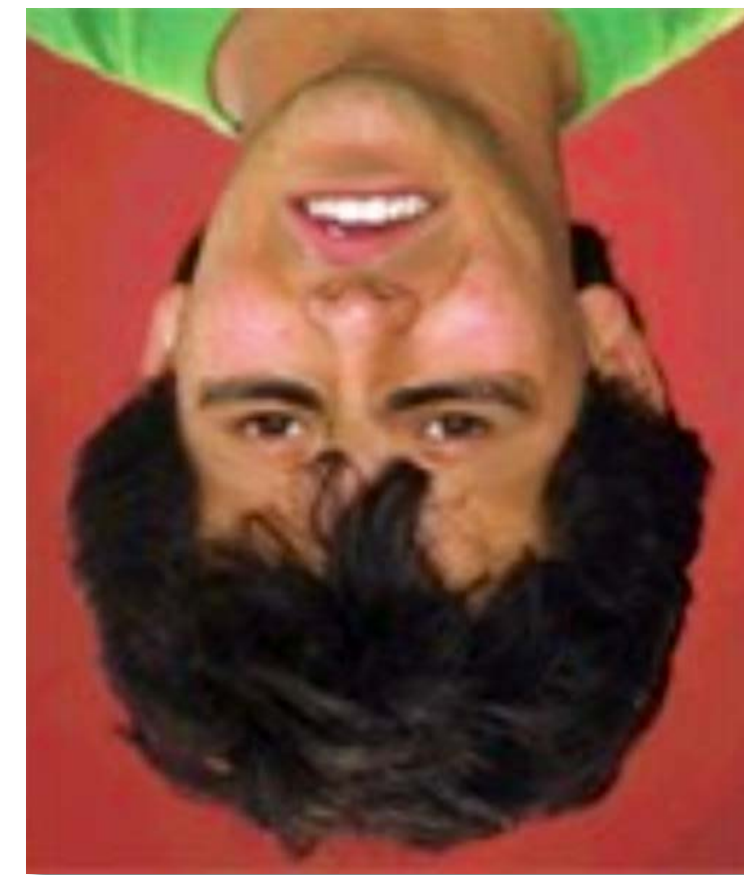


Who is she?



How different from
the other one?

Why Faces?



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

Why Faces?

Face recognition is an innate ability

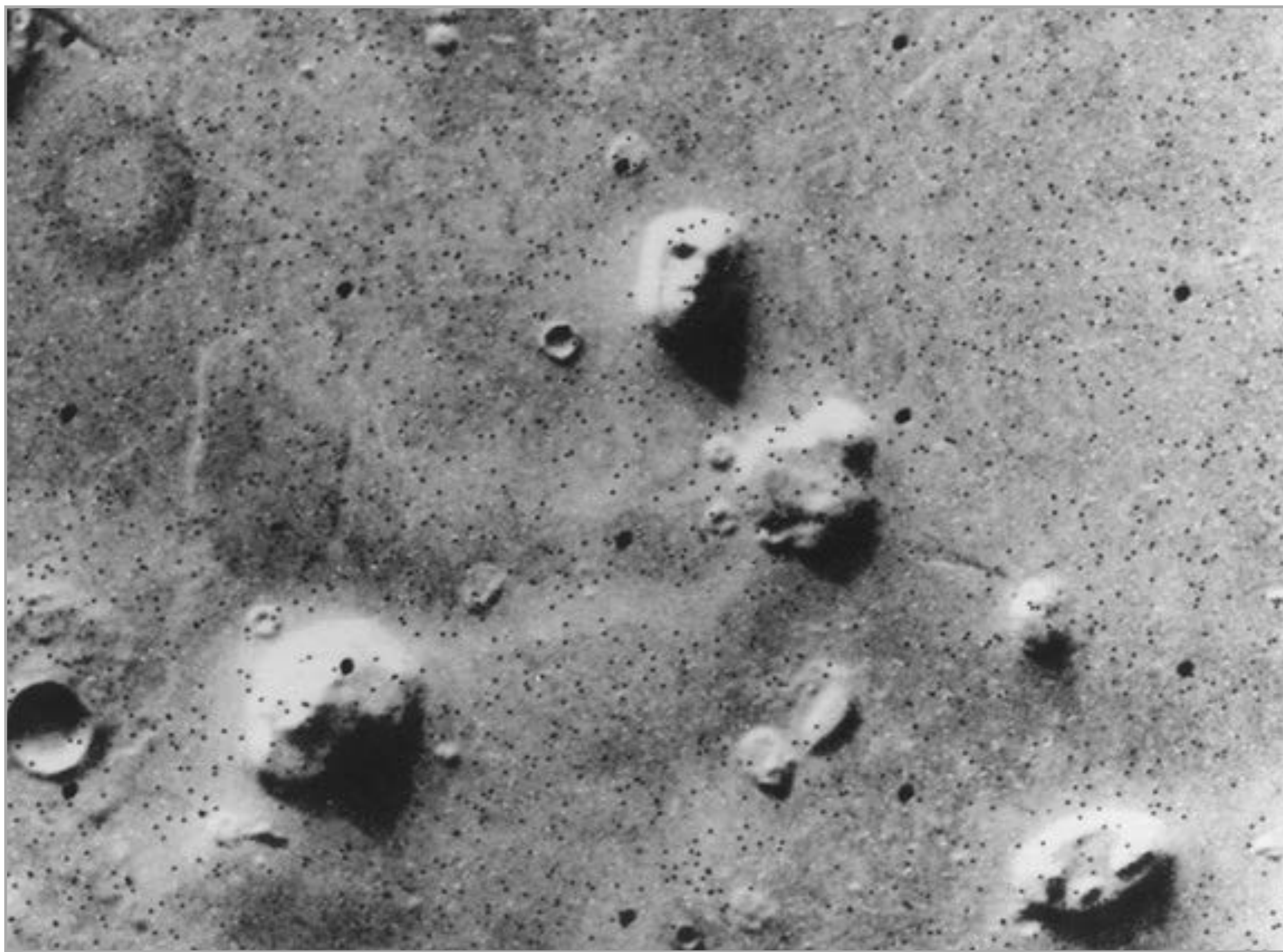
Facial Pareidolia

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



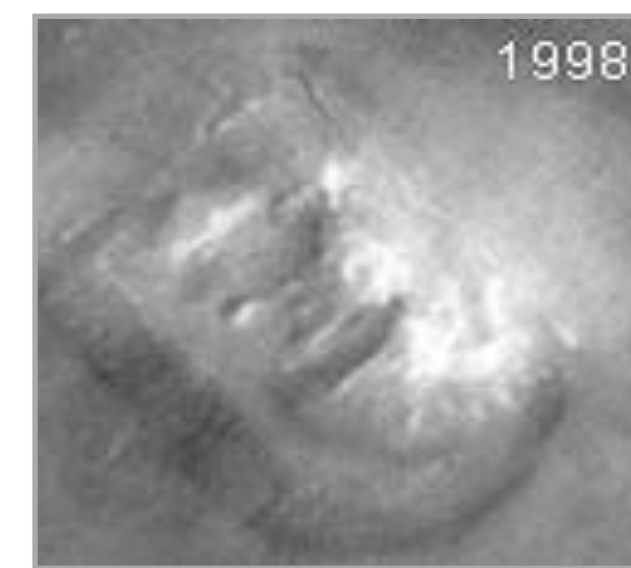
Why Faces?

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



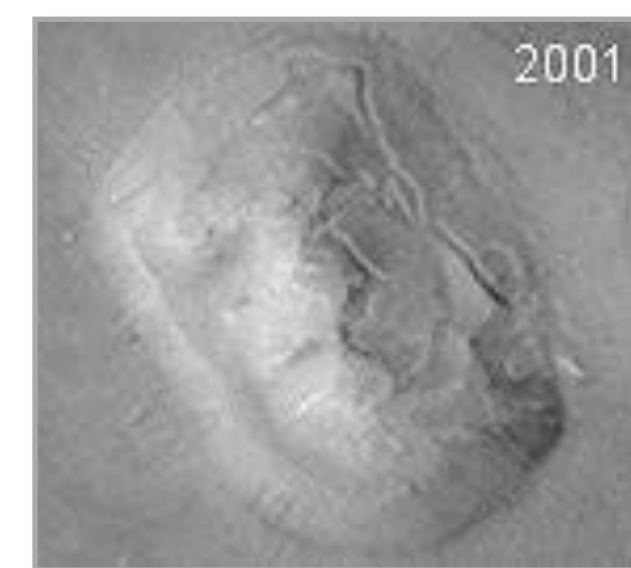
1976

1976



1998

1998



2001

2001

Why Faces?

Slave's Market
Salvador Dalí



Why Faces?

Slave's Market
Salvador Dali



**Perceptual
Rivalry**



Voltaire's Bust
Jean-Antoine Houdon

Why Faces?



The Fruit Basket
Giuseppe Arcimboldo



The Gardener
Giuseppe Arcimboldo

**Perceptual
Rivalry**

Why Faces?



The Fruit Basket
Giuseppe Arcimboldo



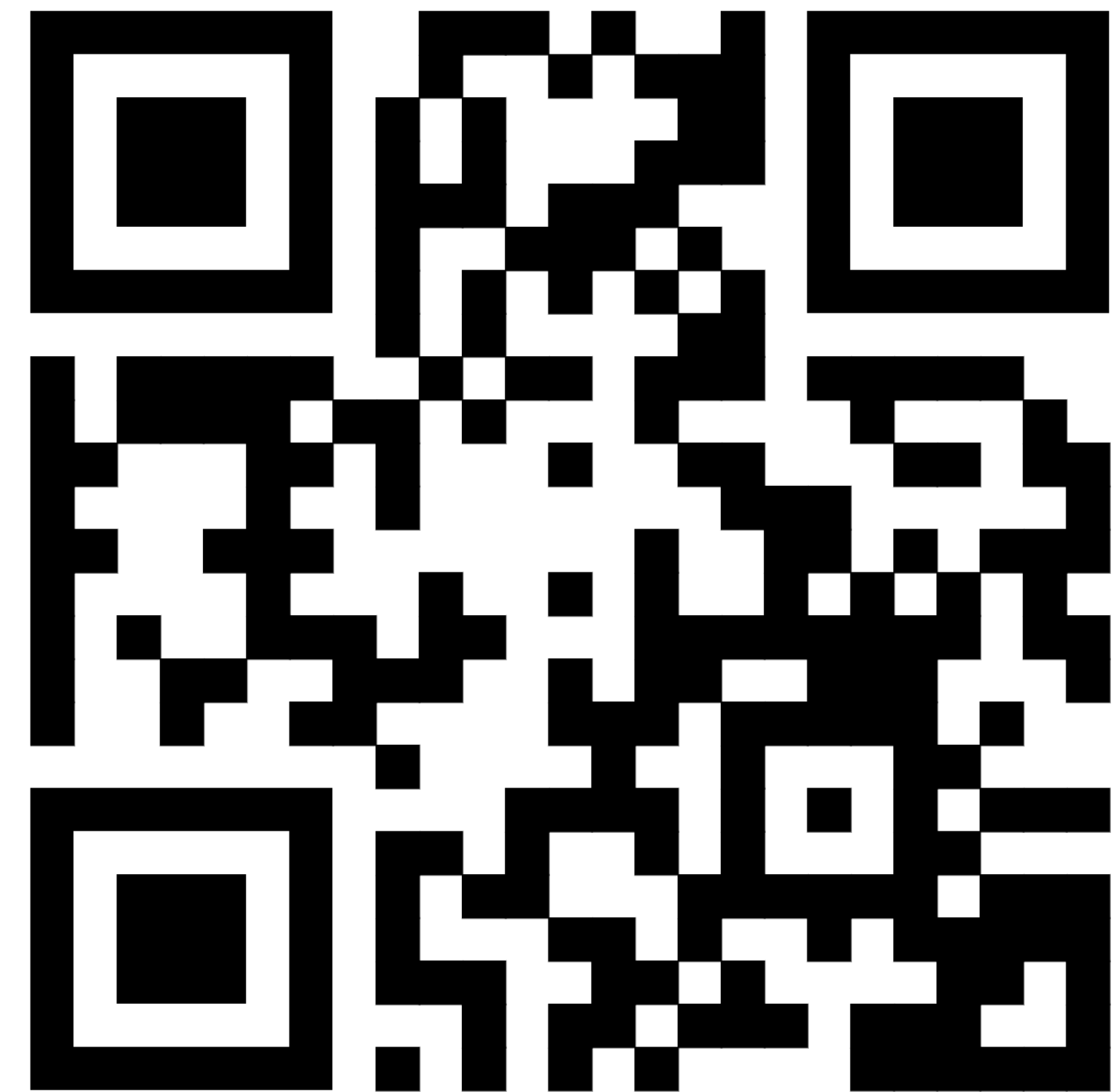
The Gardener
Giuseppe Arcimboldo

**Perceptual
Rivalry**

Fingerprints vs. Faces

How do they compare?

bit.ly/45IZPUo



Fingerprints vs. Faces

Universality (1/8)

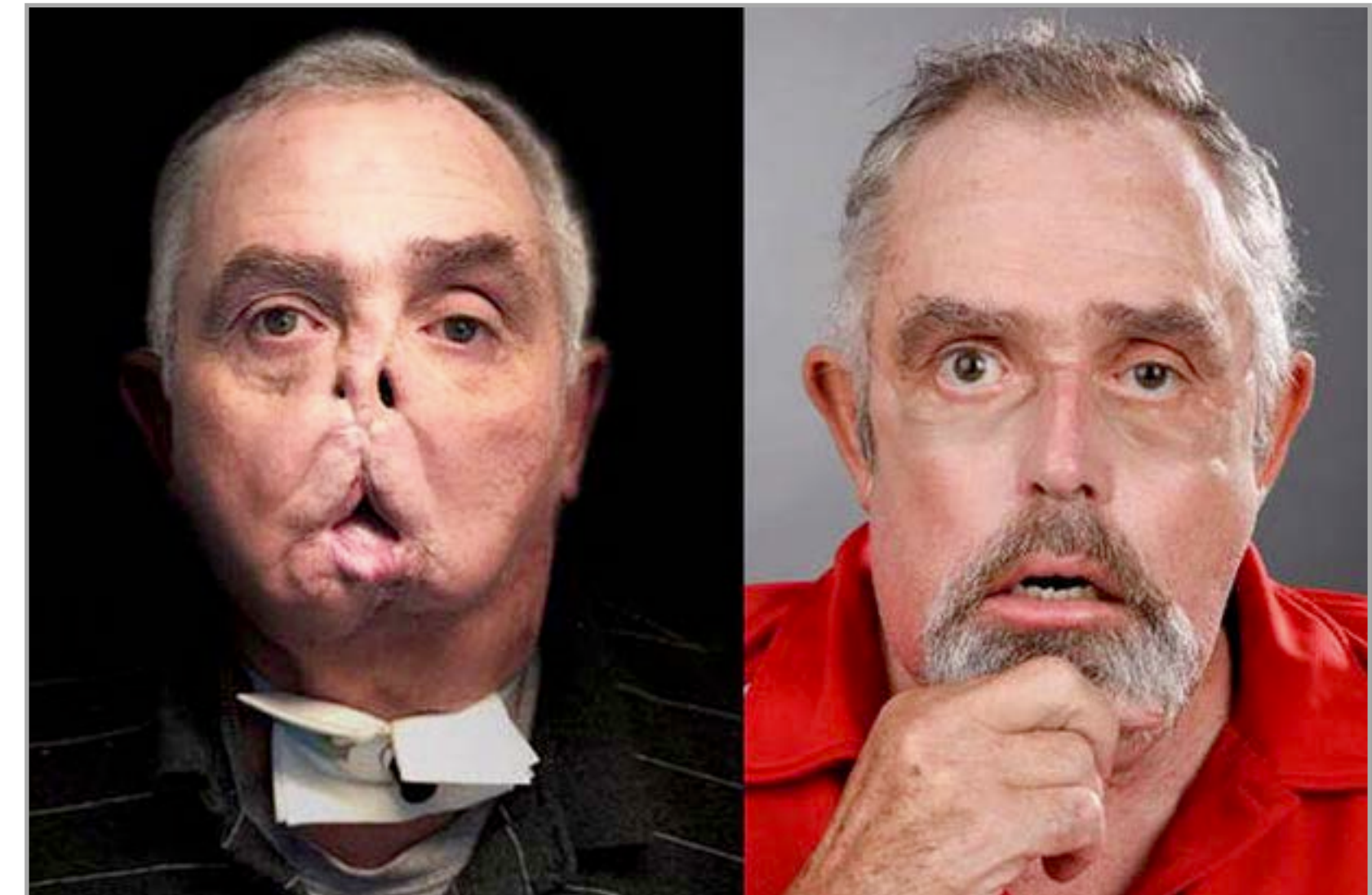
Does everybody have the trait?

<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

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.

Identical Twins?



Identical Twins?

Source: John Daugman
Lecture Notes, 2018



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Source: John Daugman
Lecture Notes, 2018

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



Mother and daughter.

Identical Twins?

Source: John Daugman
Lecture Notes, 2018



Source: John Daugman
Lecture Notes, 2018

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



Mother and daughter.



Source: John Daugman
Lecture Notes, 2018

Unrelated.



Completely
unrelated
subjects.



Source: John Daugman
Lecture Notes, 2018



Fingerprints vs. Faces

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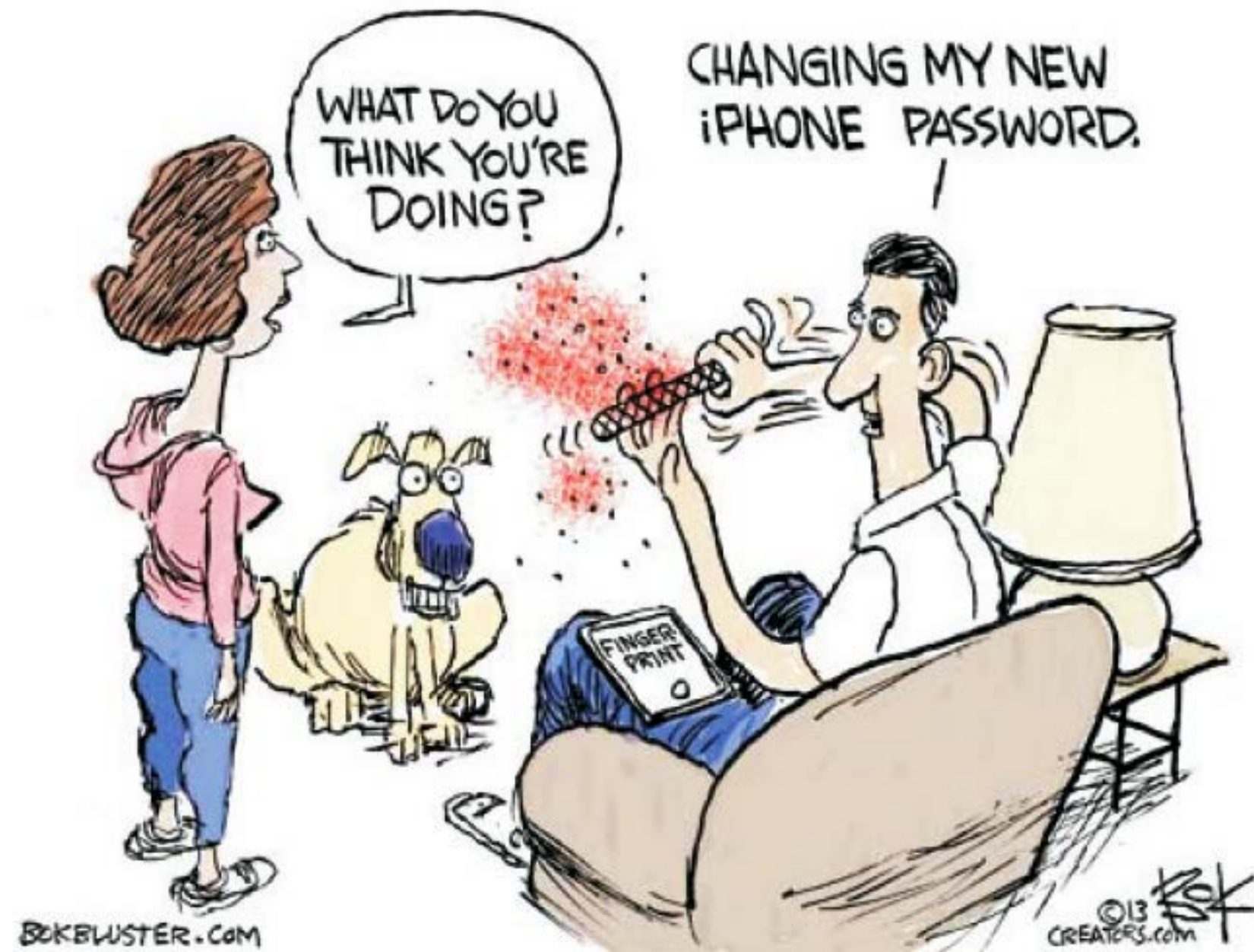


Identical twins.

Fingerprints vs. Faces

Permanence (3/8)

How easily does the trait change?



You cannot easily change your fingerprints.



But your face **will** change.

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



Fingerprints vs. Faces

Permanence (3/8)

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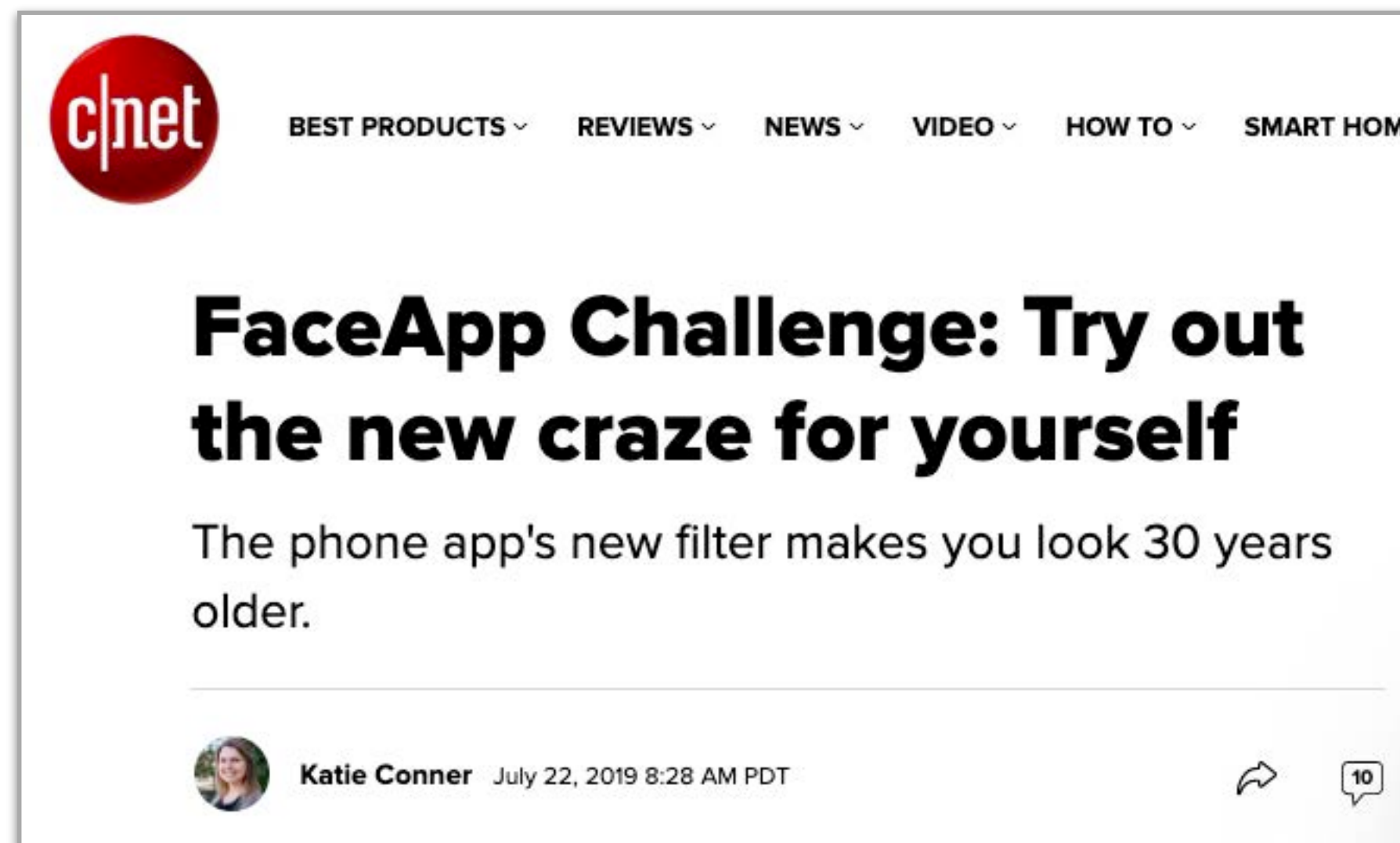
Fingerprints vs. Faces

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/>



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)

Fingerprints vs. Faces

Permanence (3/8)

How easily does the trait change?

Deliberate Changes



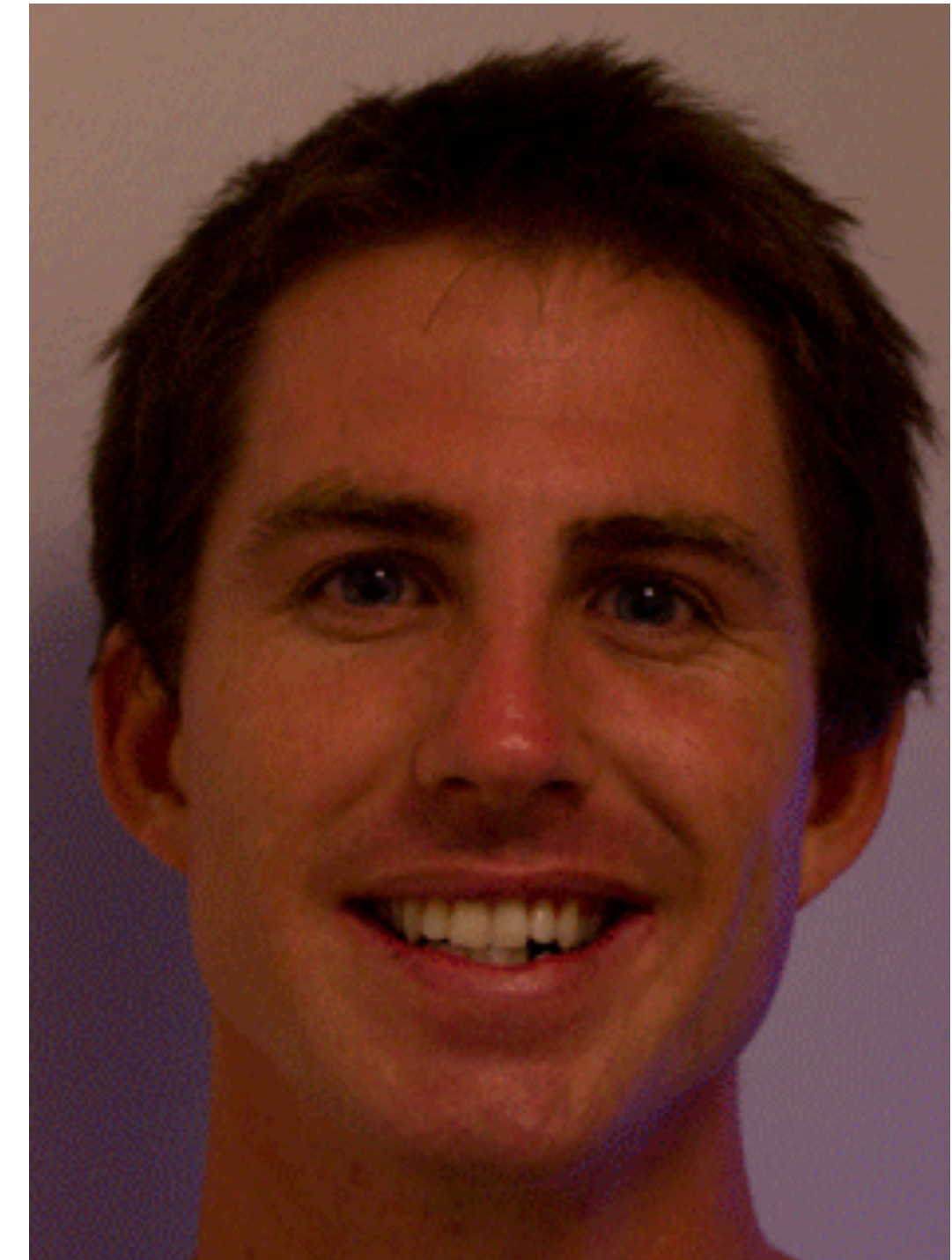
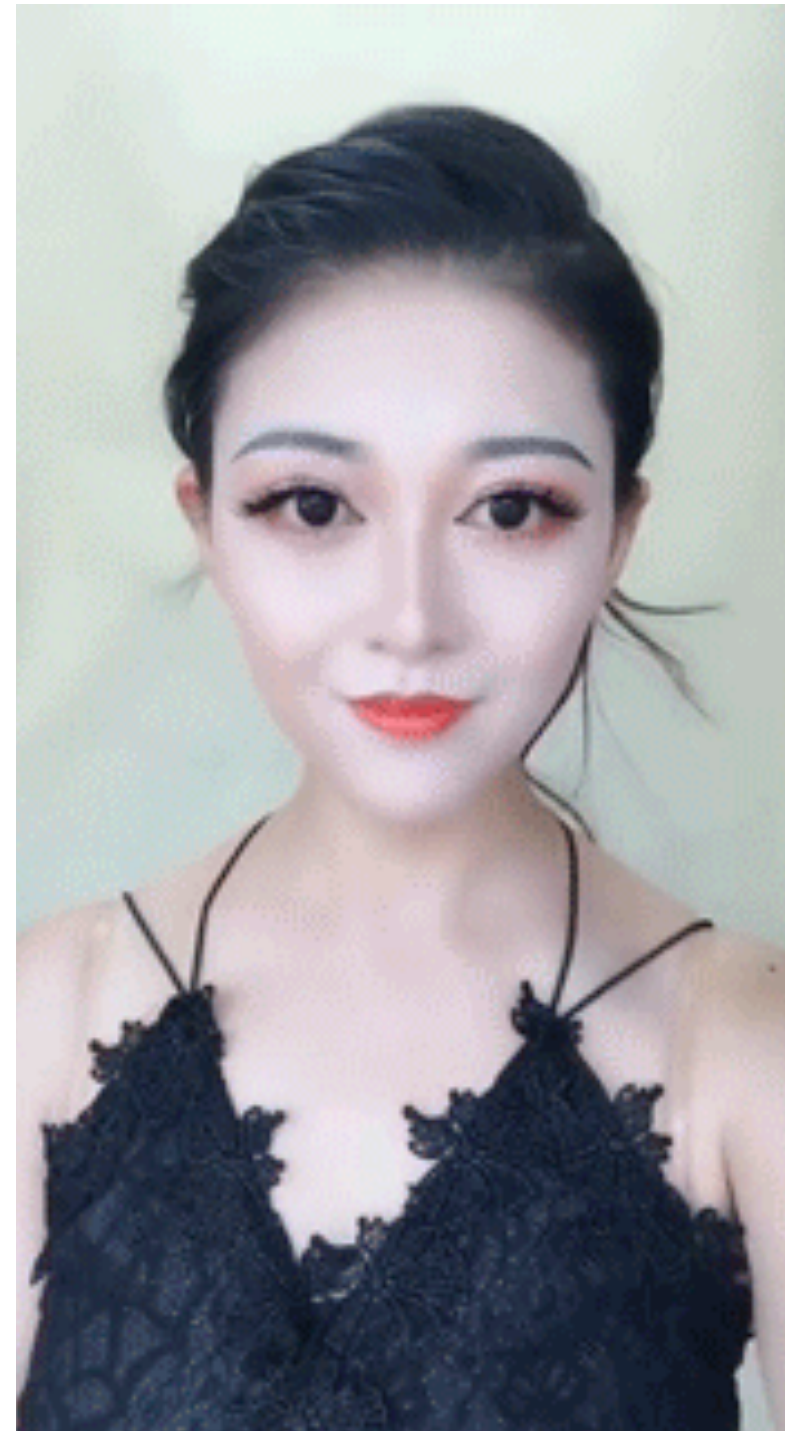
Fingerprints vs. Faces

Permanence (3/8)

How easily does the trait change?

Deliberate Changes

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

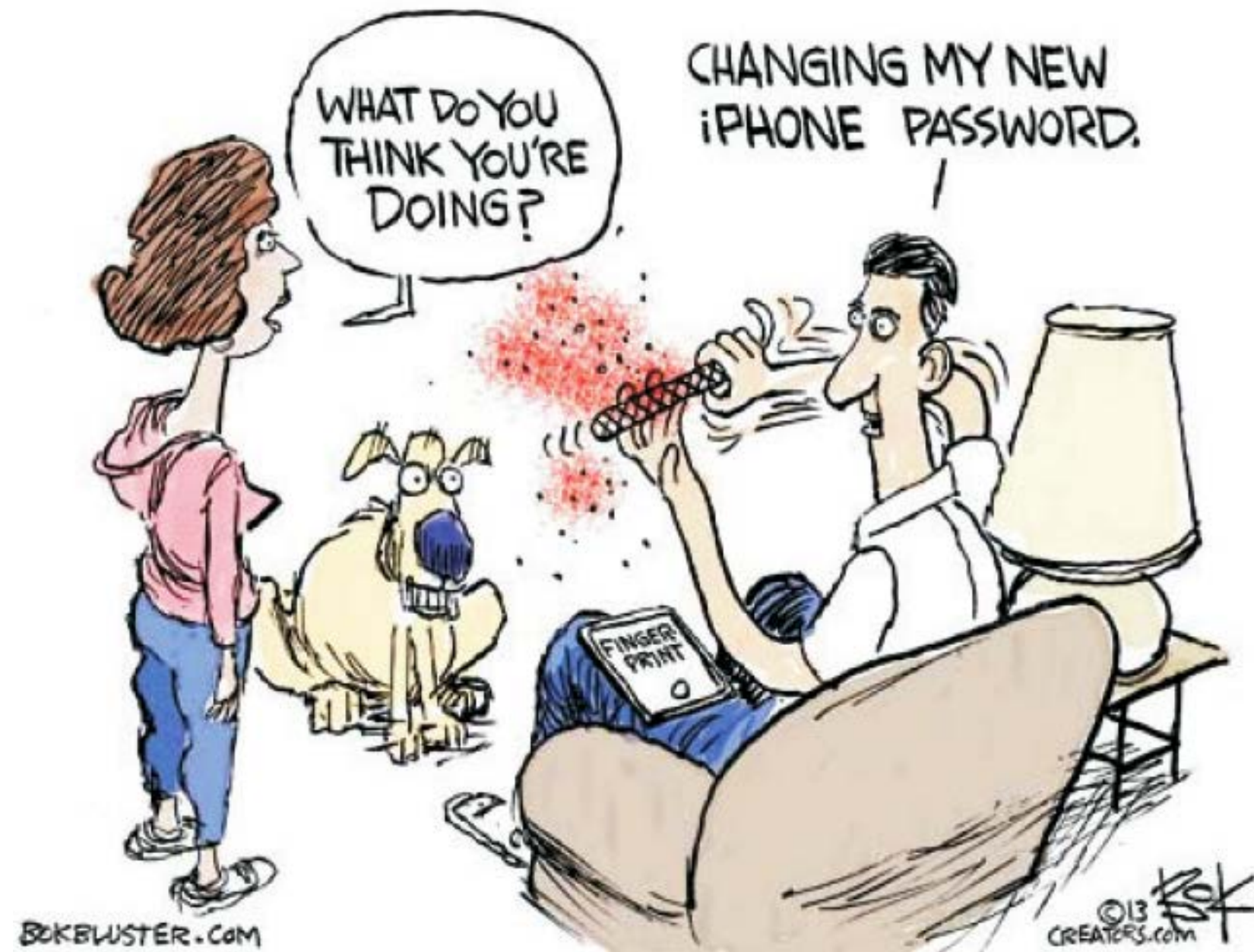




Fingerprints vs. Faces

Permanence (3/8)

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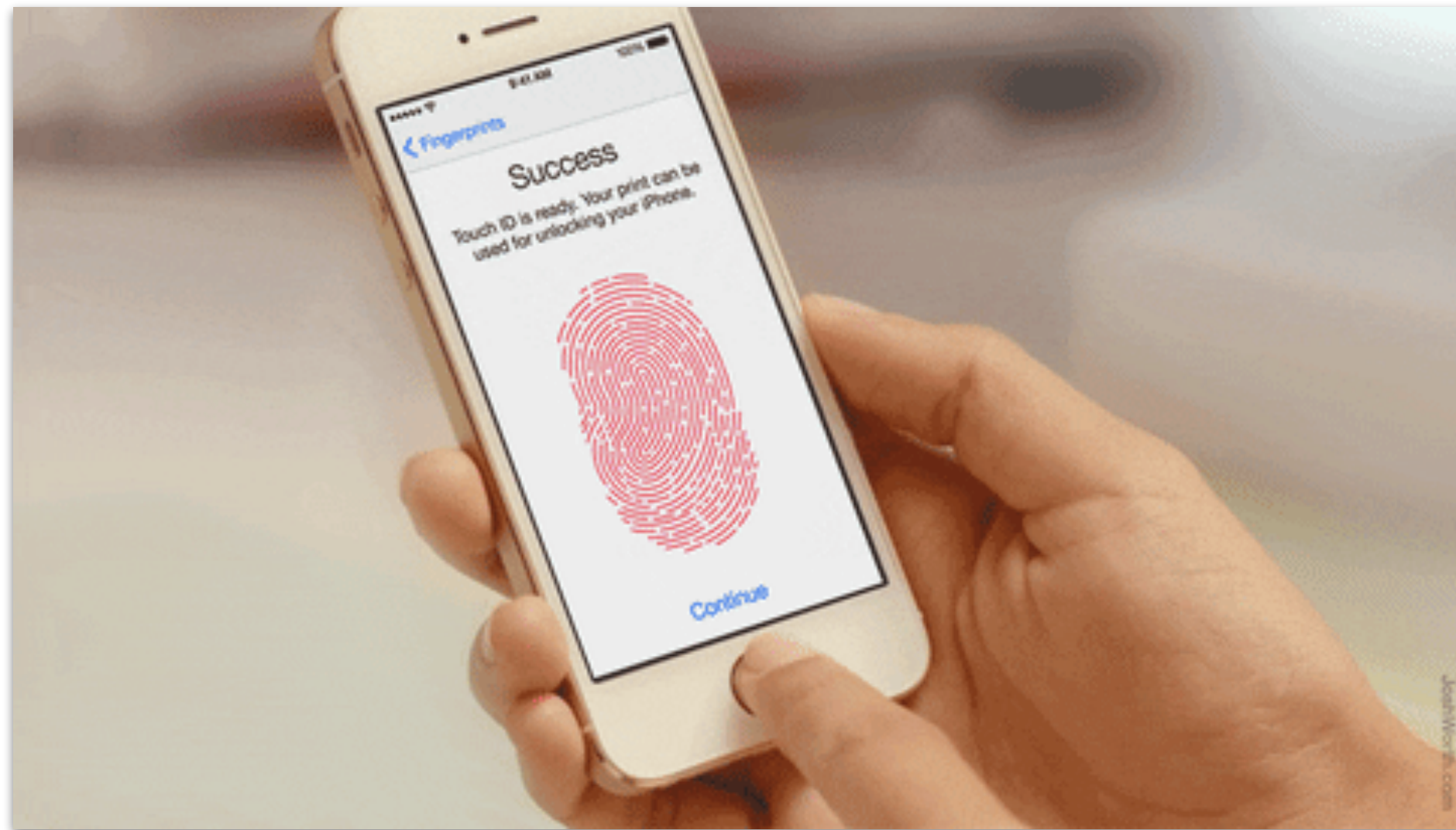


But your face **will** change.

Fingerprints vs. Faces

Measurability (4/8)

How easy is it to acquire and digitize the trait?



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

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>

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.

Fingerprints vs. Faces

Acceptability (5/8)

Will individuals collaborate during data collection?



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



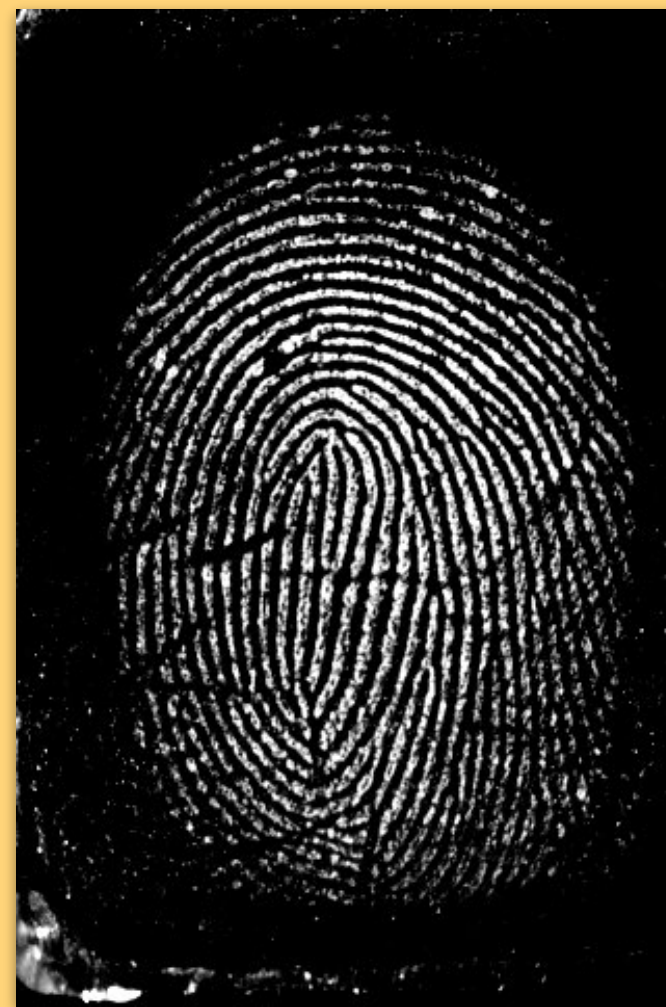
https://www.youtube.com/watch?v=BYN4oF_bi4c

Fingerprints vs. Faces

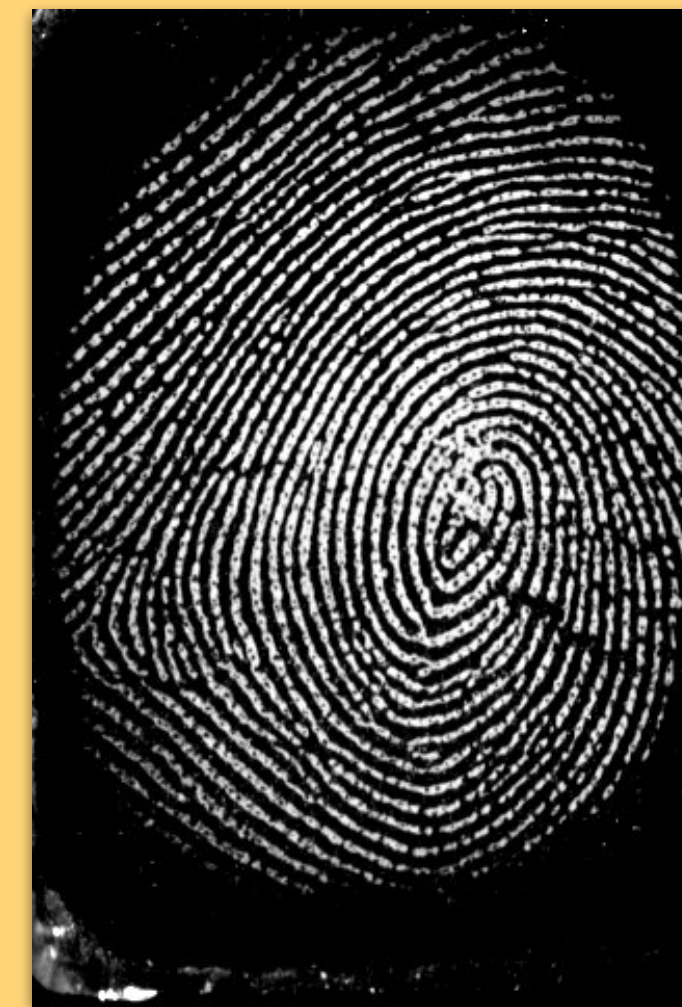
Acceptability (5/8)

Will individuals collaborate during data collection?

Privacy Concerns



Robert
Downey Jr.



Scarlet
Johansson

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?

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.

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”

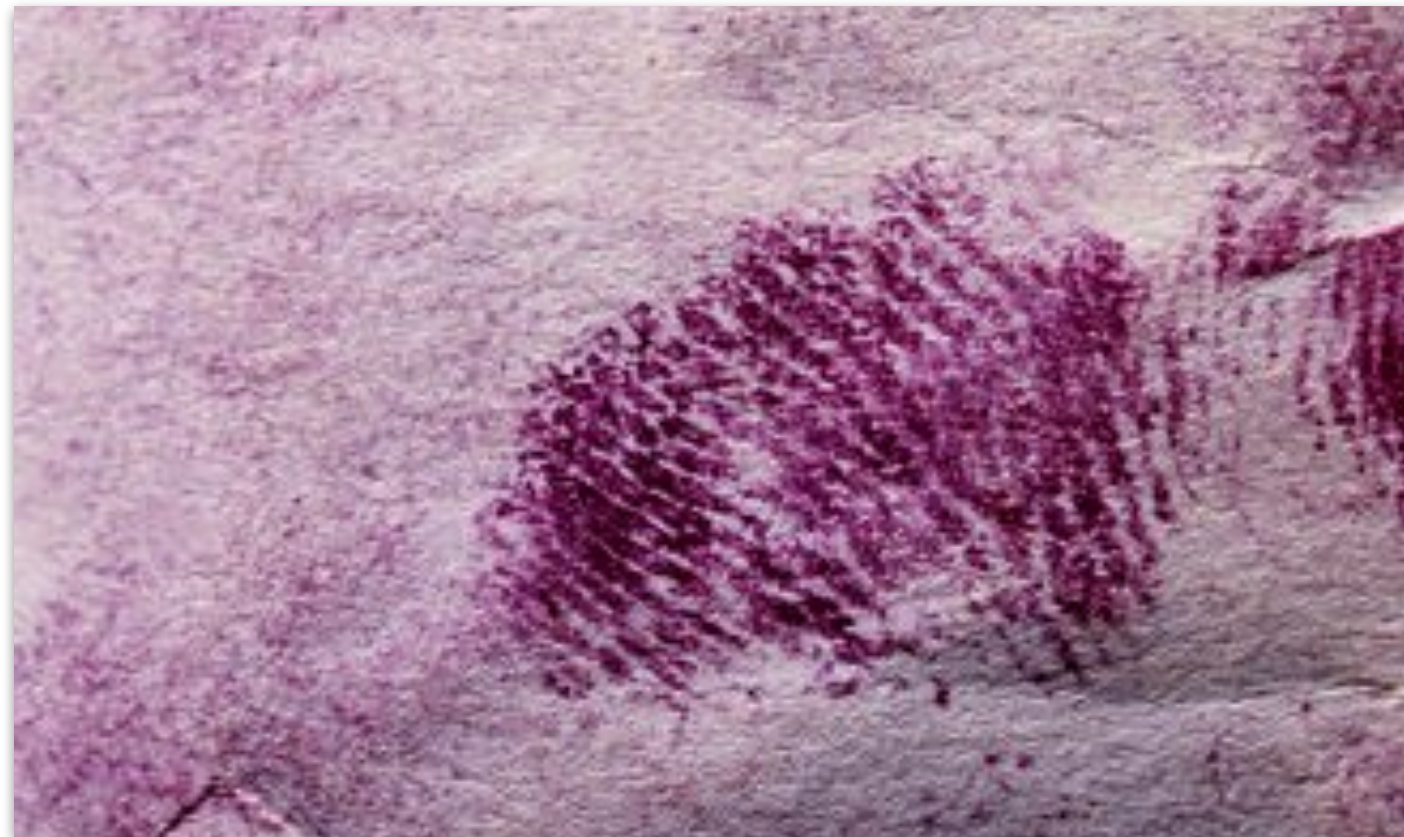
Fingerprints vs. Faces

Acceptability (5/8)

Will individuals collaborate during data collection?

Privacy Concerns

Which trait favors **covert** deployment?



Latent Fingerprint



“Latent Face”

Fingerprints vs. Faces

Circumvention (6/8)

How easy can the trait be forged or imitated?



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



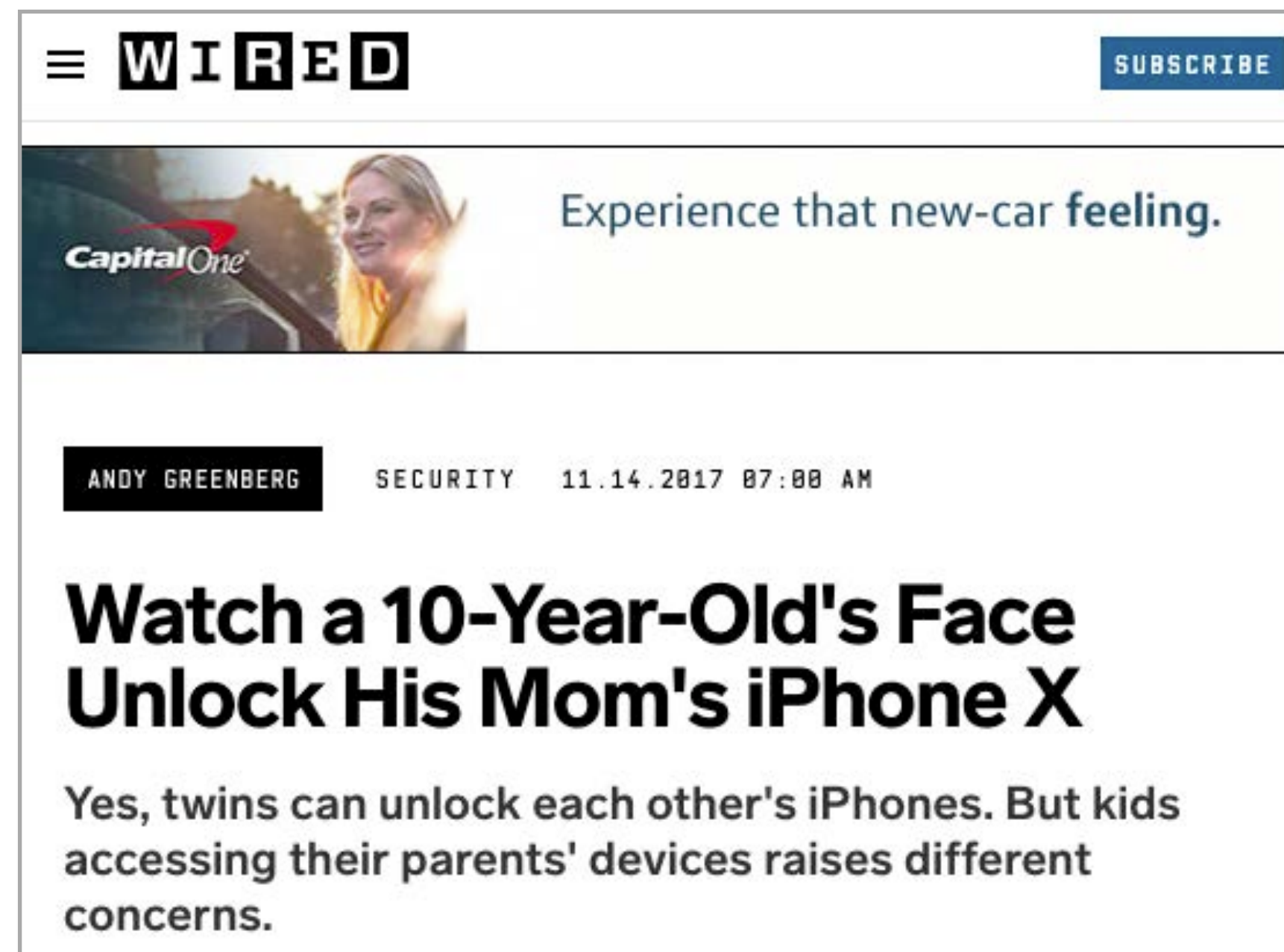
We are not there yet!

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/>

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>

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.

Fingerprints vs. Faces



Performance (8/8)

How good is the trait quantitatively according to objective metrics?

Face Recognition Improvement

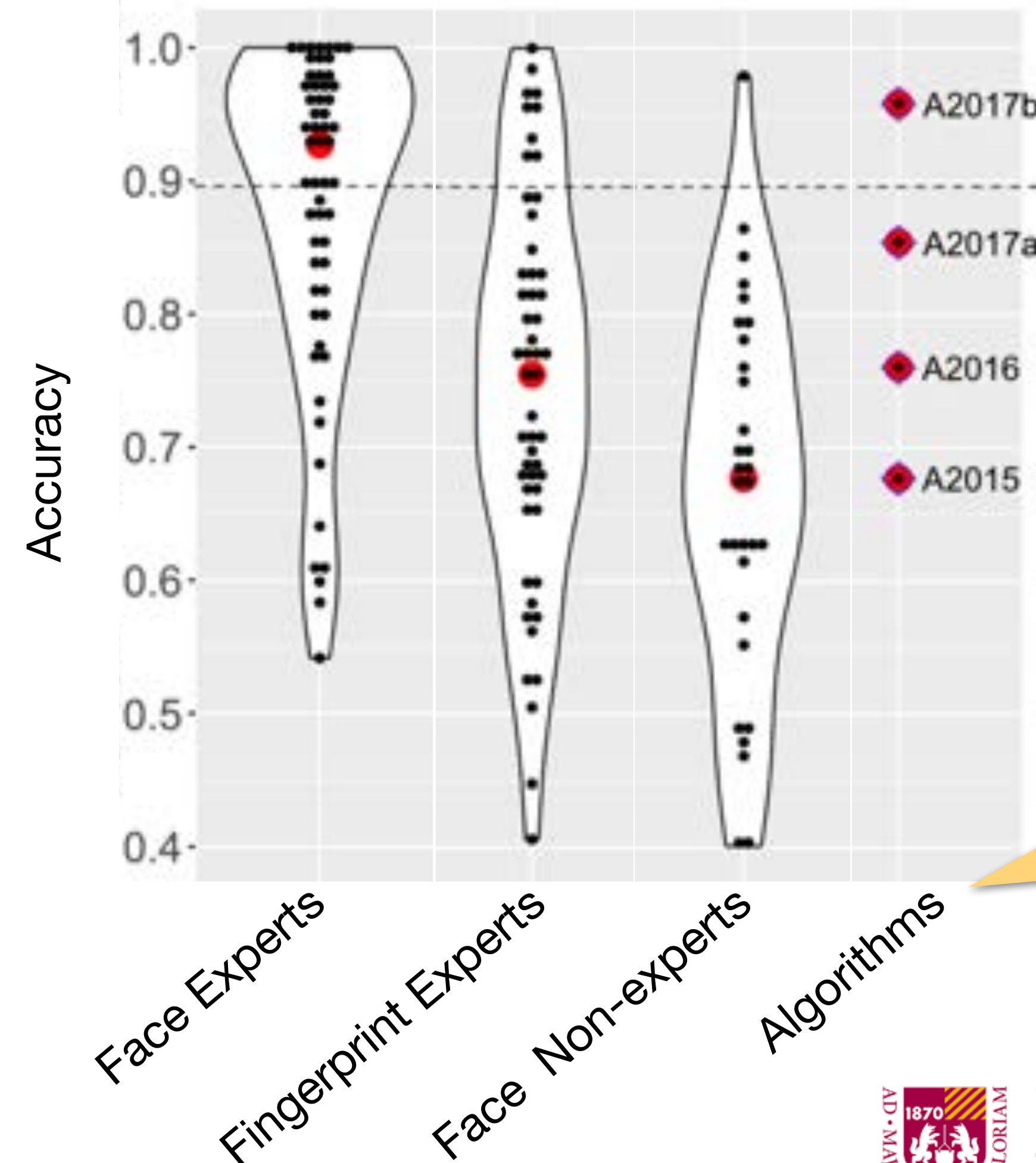
Methods are improving quickly.
Benefits from deep learning.

Publication

Phillips et al.

Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms.

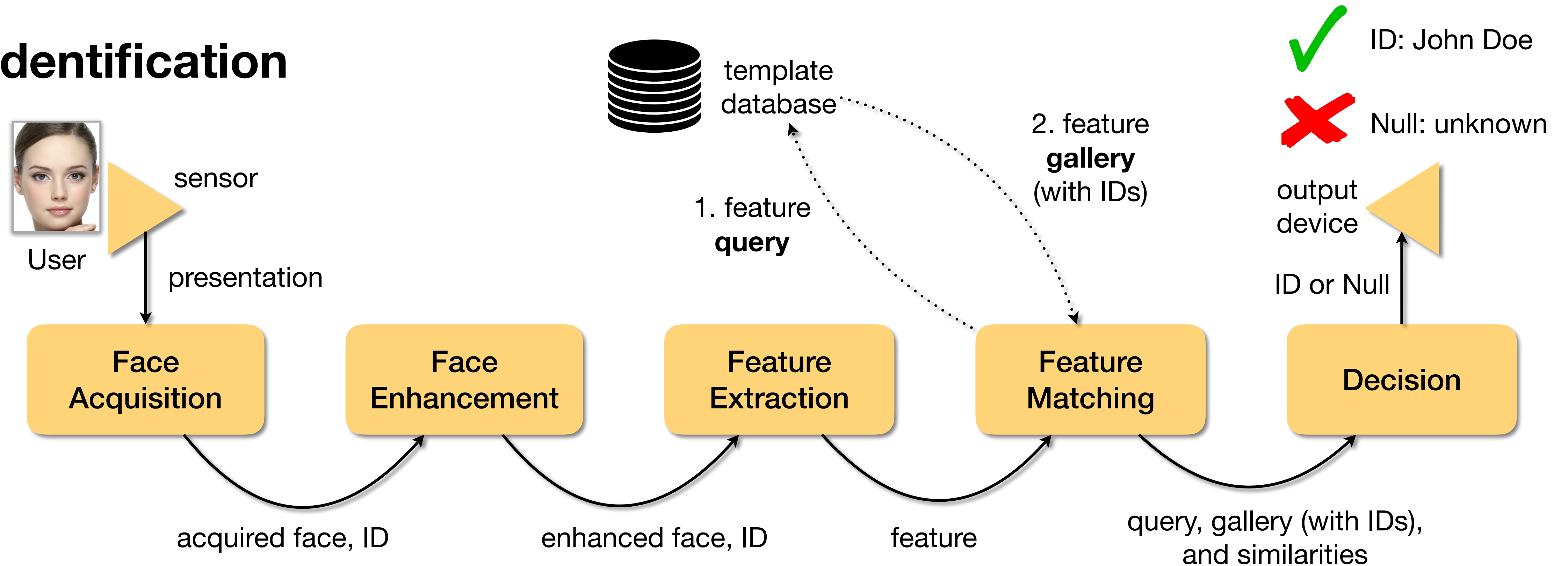
PNAS, 2018



Deep Learning

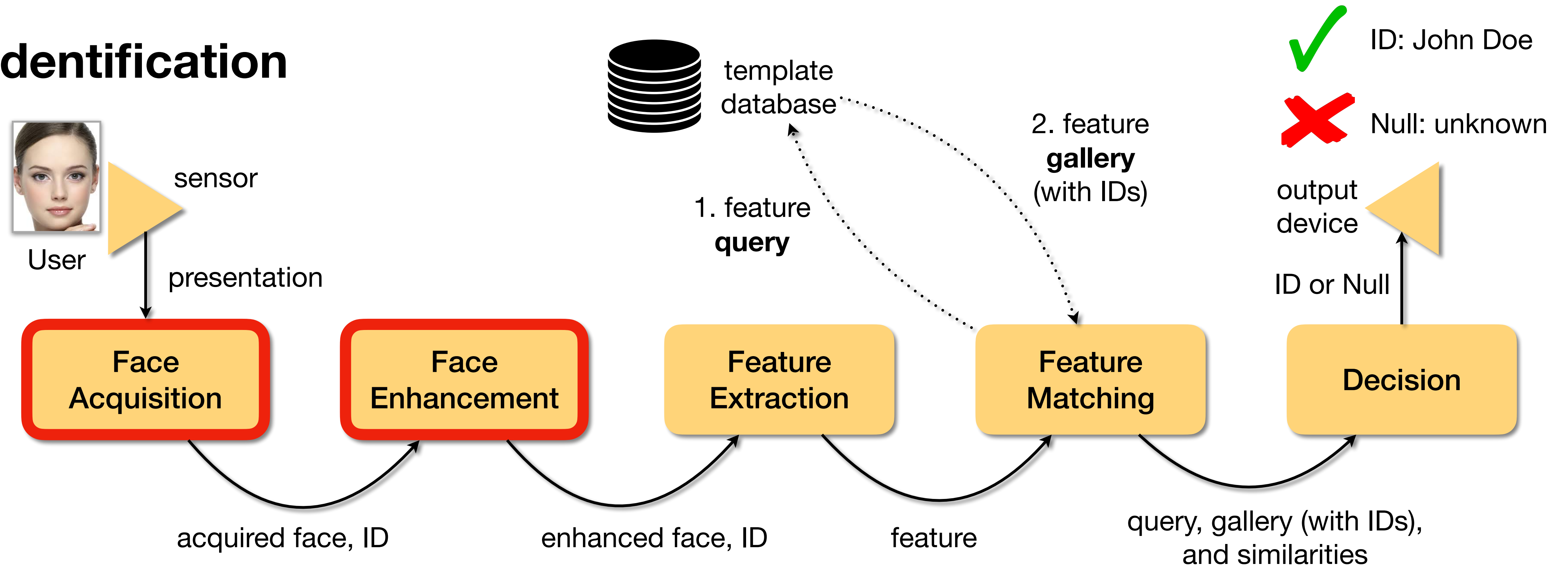
Face Recognition

Identification



Face Recognition

Identification



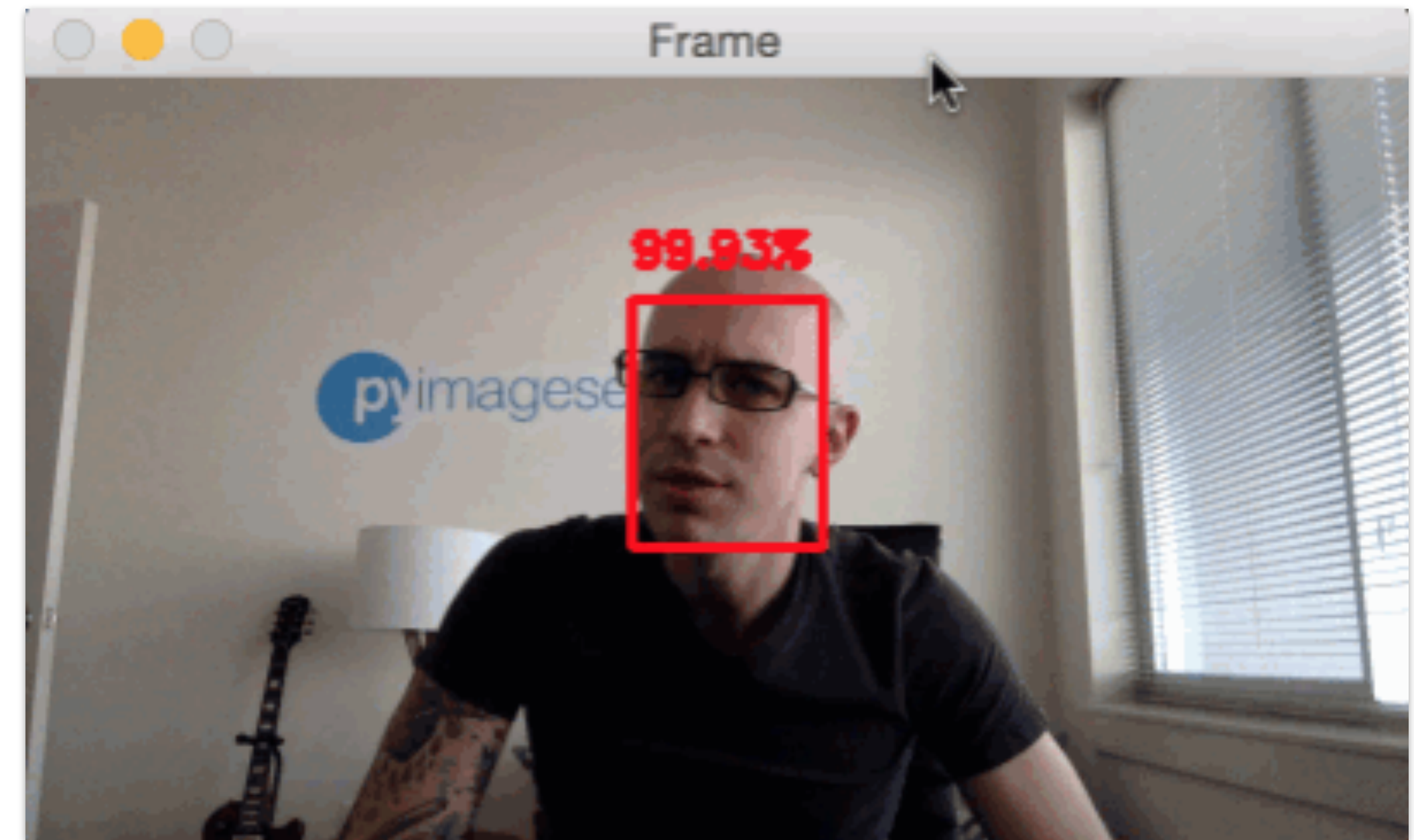
What's Next?

Face Recognition Pipeline

Face acquisition and
face detection/localization.

Fill out your
Today-I-missed Statement

Please visit
sakai.luc.edu/x/BCJs8K.



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