Biometrics: Past, Present and Future

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http://biometrics.cse.msu.edu/

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IAPR/IEEE Winter School on Biometrics

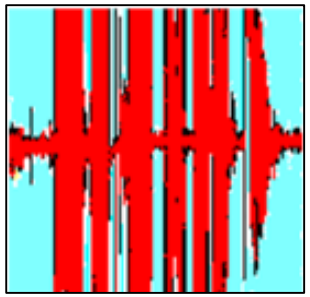
Outline

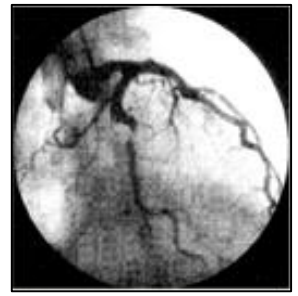
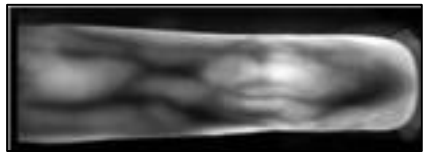
- Introduction
  - What is Biometrics?
  - Why Biometrics?
- Past
- Present
- Future

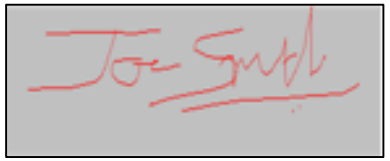
Biometric Recognition

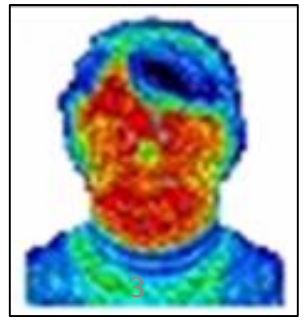
- ***"Automated recognition of individuals based on their behavioral and biological characteristics"*** *ISO/IEC JTC1 2382-37:2012*

- ***Bios: life; Metron: measure*** *(Morris,1875)*

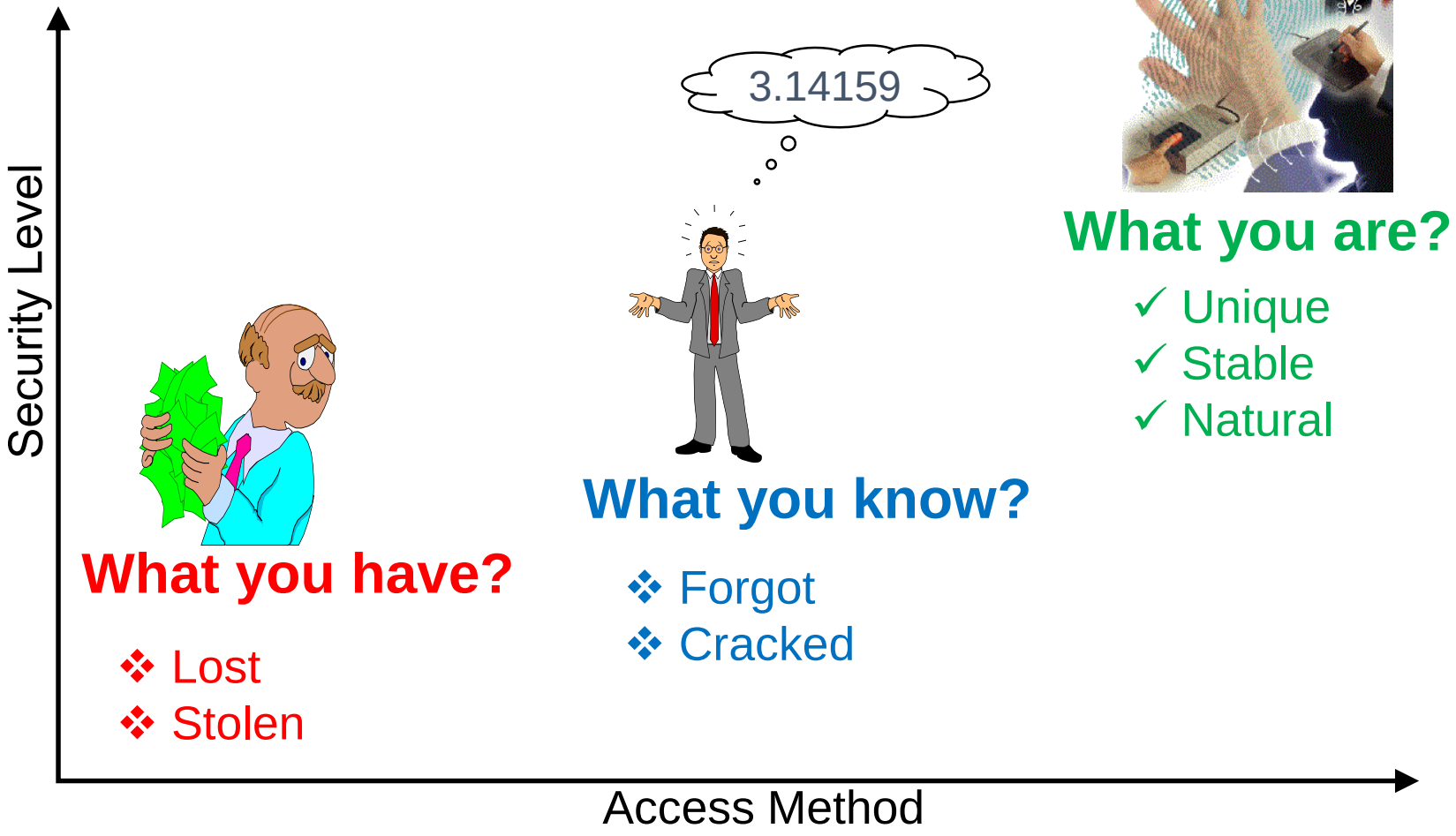






Why Biometrics?



Biometrics is Application Driven

https://www.bioenabletech.com/biometrics-atm
https://www.bayometric.com/automobile-industry-adopting-automotive-biometrics

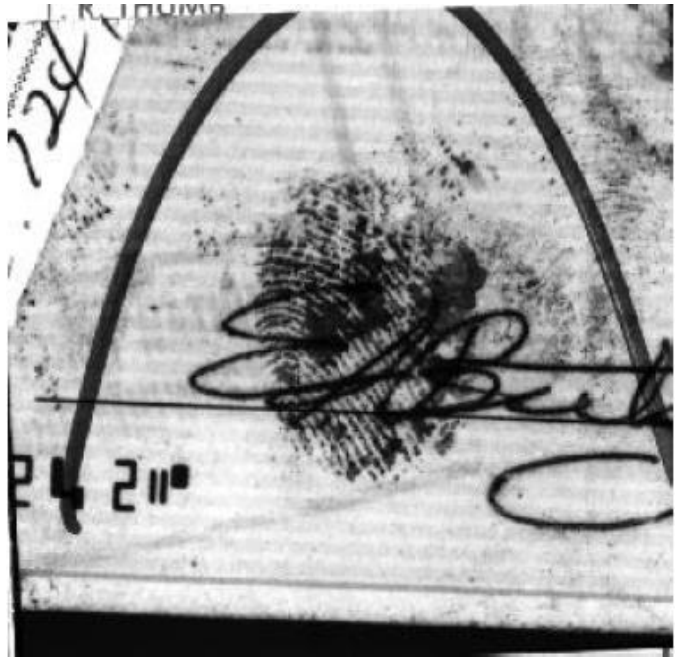
Past

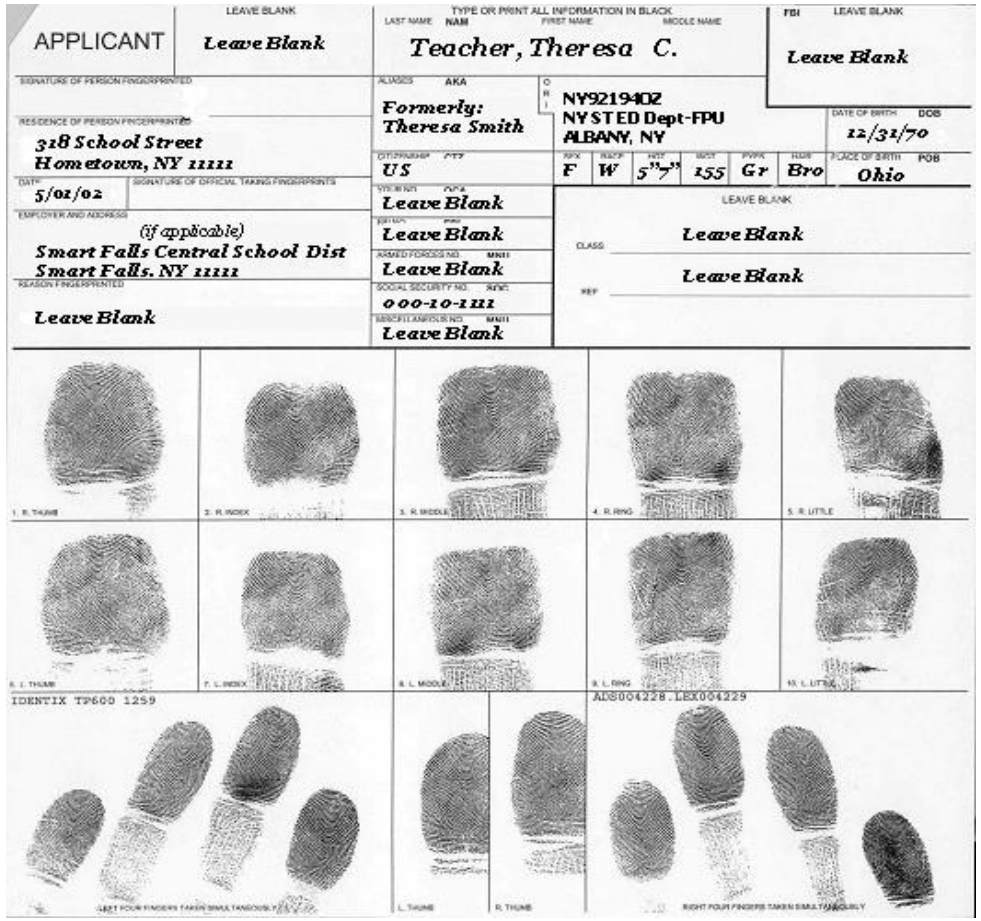
Habitual Criminal Act (1855)

“What is wanted is a means of classifying the records of habitual criminal, such that as soon as the particulars of the personality of any prisoner (*whether description, measurements, marks, or photographs*) are received, it may be possible to ascertain readily, and with certainty, whether his case is in the register, and if so, who he is”

Scotland Yard (1905)

FBI (1924)





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IDENTIX TP600 1259

AIS004228.LEX004229

1924: US Congress authorizes DOJ to collect fingerprints and arrest information

Michigan Forensics Bureau

1960

AFIS (1989); 15K comparisons/sec; no latent search

Courtesy: James Blanchard, Michigan State Police

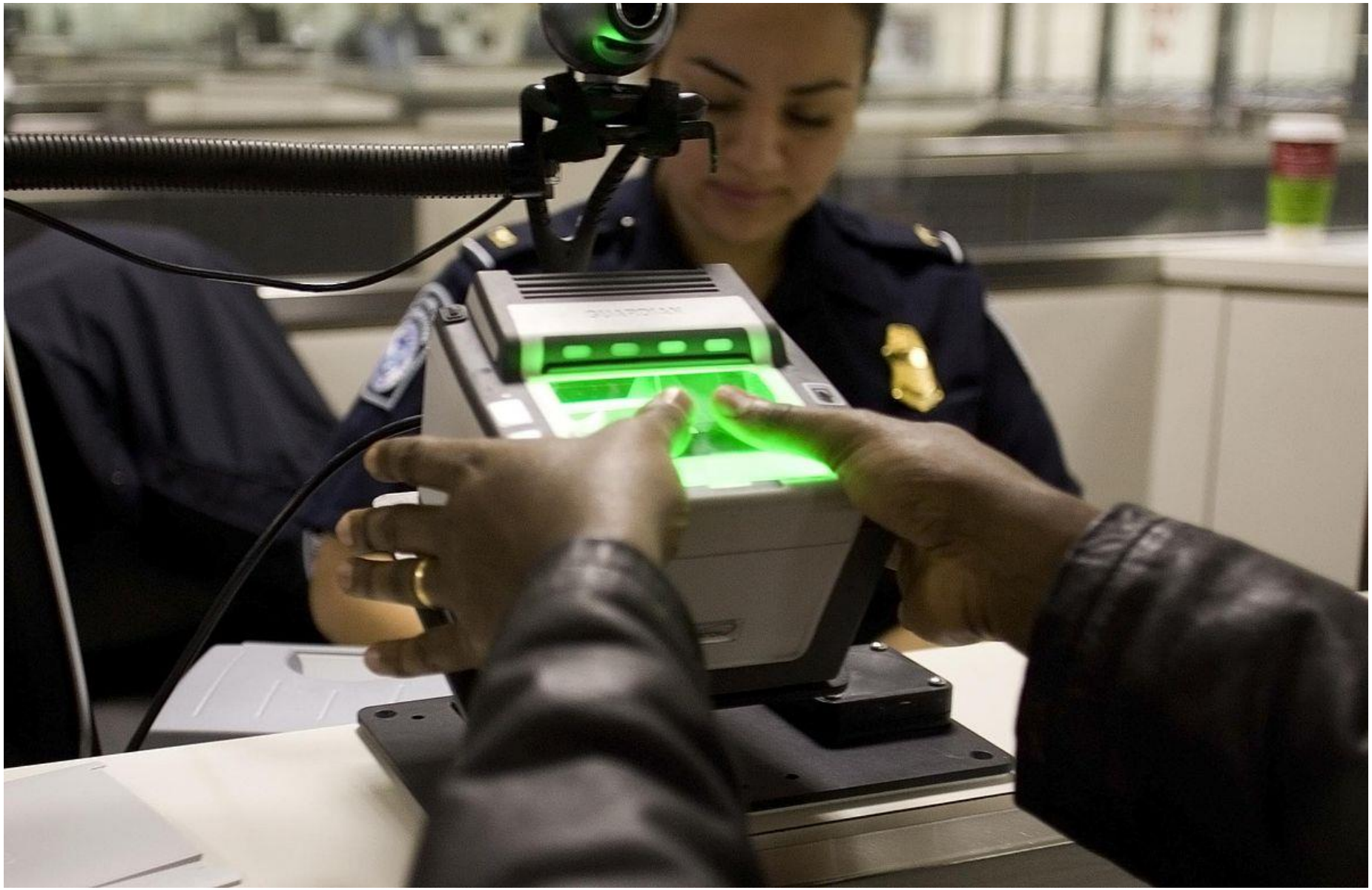
Identimate (1972)

First commercial use of biometrics

Present

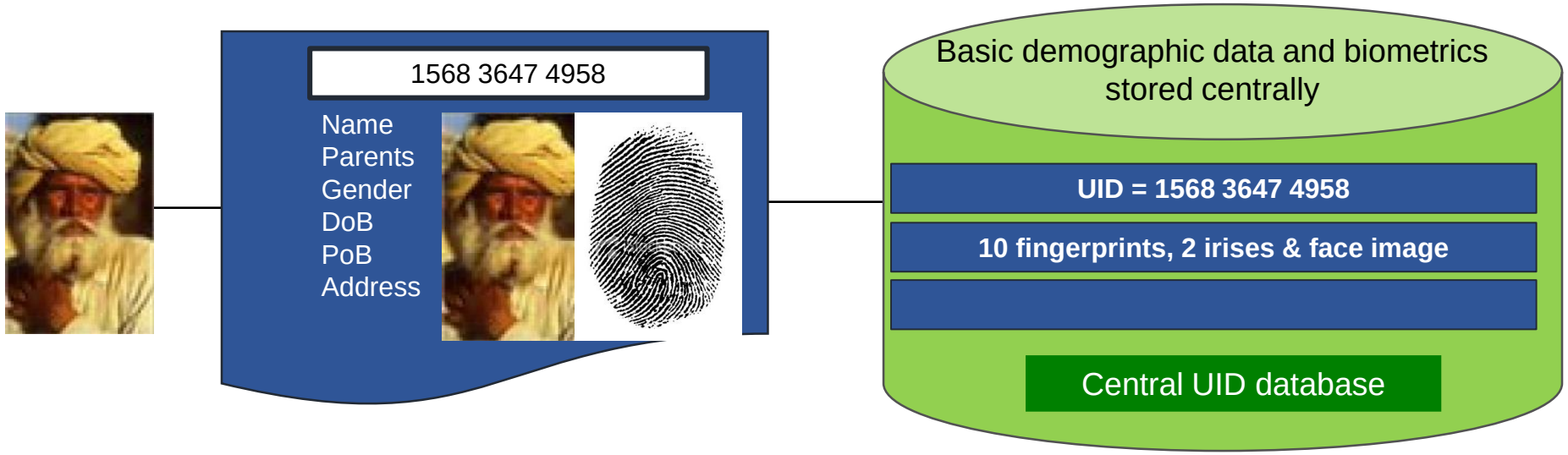
9/11 Attacks (2001)

US-VISIT (2003)



Walt Disney Theme Park (2005)

Aadhaar (2008)



“To empower residents of India with a unique identity and a digital platform to authenticate anytime, anywhere.”

https://uidai.gov.in/

Authentication (ongoing)

https://uidai.gov.in/aadhaar_dashboard/auth_trend.php

Two-factor authentication: 40 M authentications/day

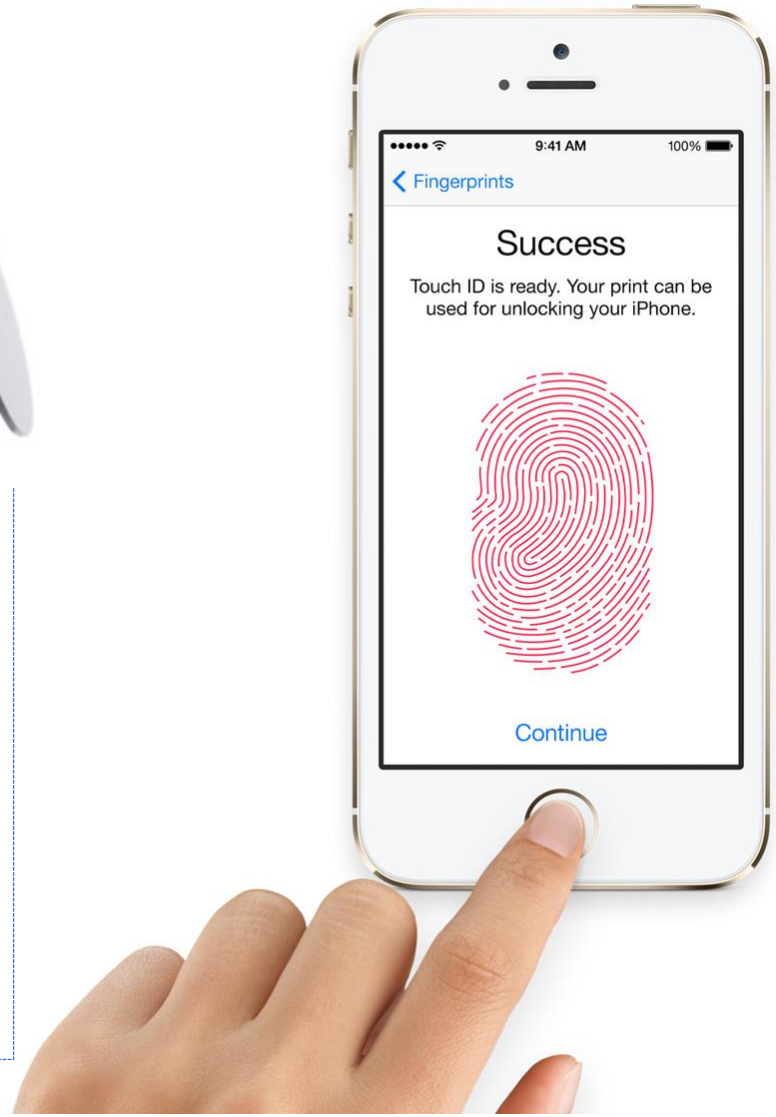
Apple Touch ID (2013)

Tactile Switch

Capacitive Single-Touch Sensor

Stainless Steel Detection Ring

Laser-Cut Sapphire Crystal



Apple Face ID (2017)

In-display Fingerprint Sensor (2018)

Entry/Exit system at Airports (2019)

Exit (leaving the country)

Entry (arriving from overseas)

https://www.cnn.com/travel/article/airports-facial-recognition/index.html (8th October 2019)

Amazon Go (2019)

https://www.forbes.com/sites/andriacheng/2019/06/26/amazon-gos-even-bigger-rollout-is-not-a-matter-of-if-but-when/#67d1a28d6f52

Authentication Accuracy

Same Person?

Fingerprint: TAR = 99.96% @ FAR = 0.01% (FVC-ongoing)

Iris: TAR = 99.82% @ FAR = 0.01% (NIST IREX II)

Face: TAR = 99.7% @ FAR = 0.1% (NIST FRVT 2010)

Identification Accuracy

Probe

Gallery

- **Face:** FNIR = 0.058 @ FPIR = 0.001 (12M gallery)
- **Fingerprint:** (Ten fingers): FNIR = 0.001 @ FPIR = 0.001 (5M gallery);
  Single finger: FNIR = 0.019 @ FPIR = 0.001 (100K gallery)
- **Iris:** (Both eyes): FNIR = 0.0059 @ FPIR = 0.001 (500K gallery)

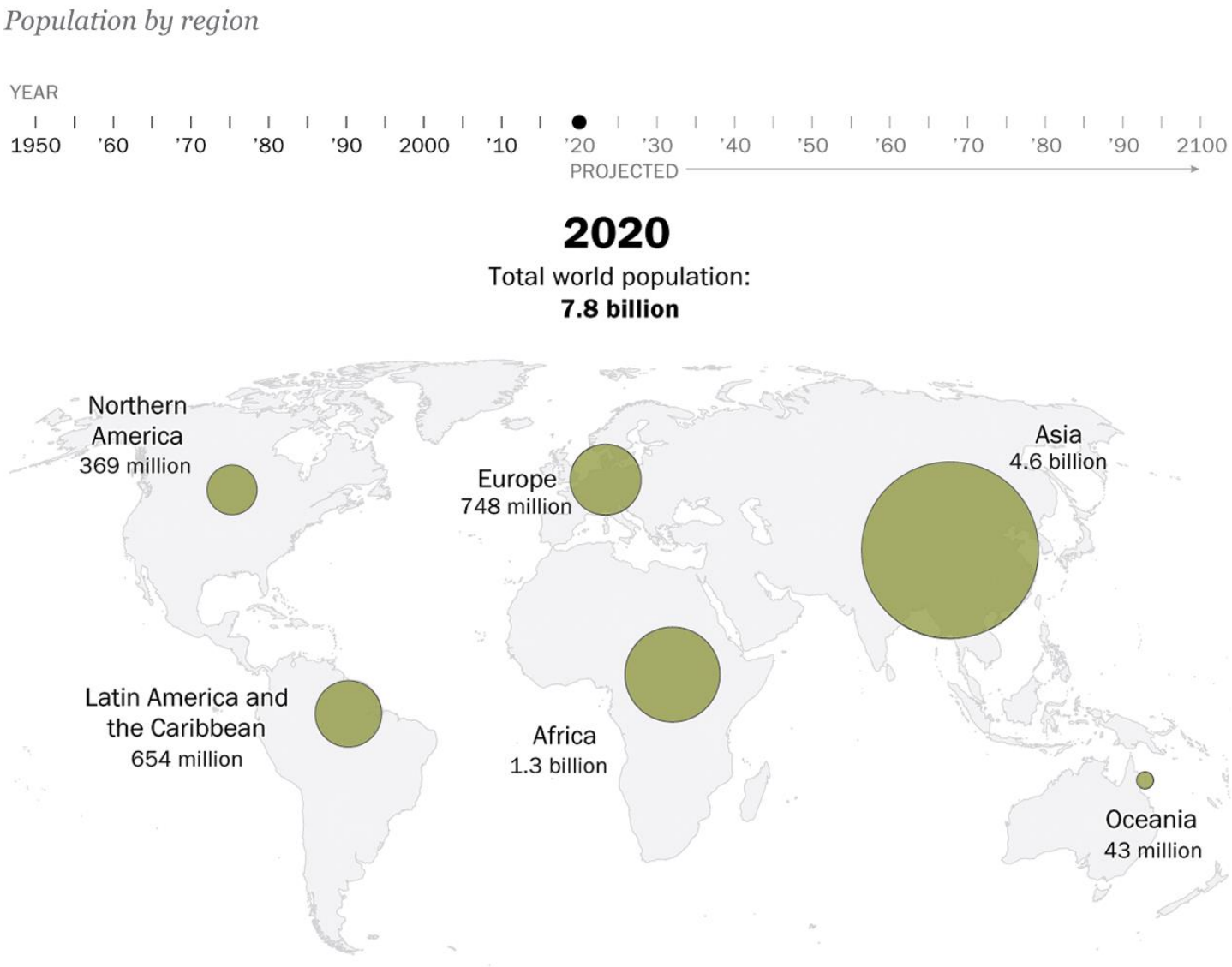
[1] NIST FRVT 1:N Identification: *https://pages.nist.gov/frvt/html/frvt1N.html*
[2] NIST FpVTE: *https://nvlpubs.nist.gov/nistpubs/ir/2014/NIST.IR.8034.pdf*
[3] NIST IREX 10 Identification Track: *https://pages.nist.gov/IREX10/*

Future

Spoofs (Minority Report, 2002)

Targeted Advertisement (Minority Report, 2002)

Biometrics at Scale



Note: Regions follow United Nations definitions and may differ from other Pew Research Center reports.
Source: United Nations, Department of Economic and Social Affairs, Population Division, "World Population Prospects 2019."

PEW RESEARCH CENTER

Network of CCTV Cameras

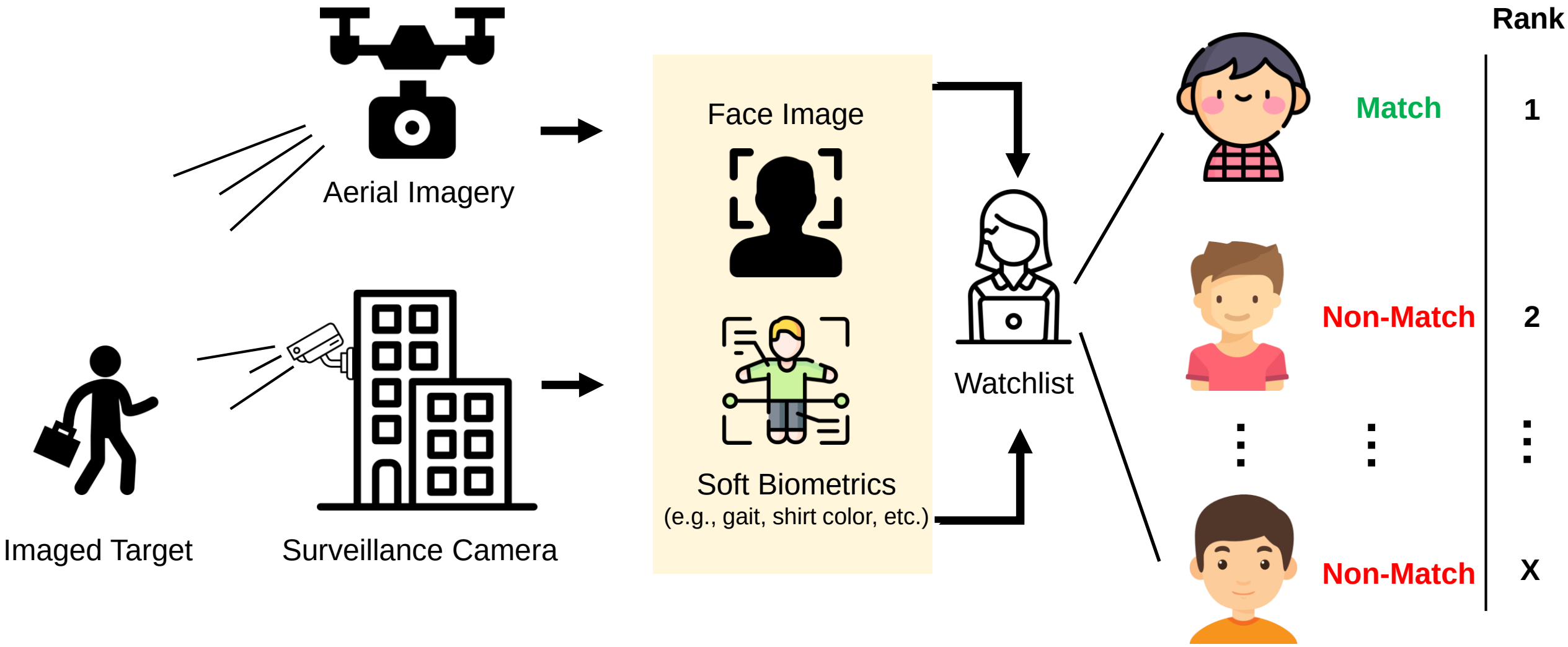
Title Scene, Person Of Interest, CBS (2011-16); An ex-assassin and a wealthy programmer save lives via a surveillance AI that sends them the identities of civilians involved in impending crimes.

https://www.nytimes.com/2021/01/14/learning/what-students-are-saying-about-the-riot-at-the-us-capitol.html

WANTED

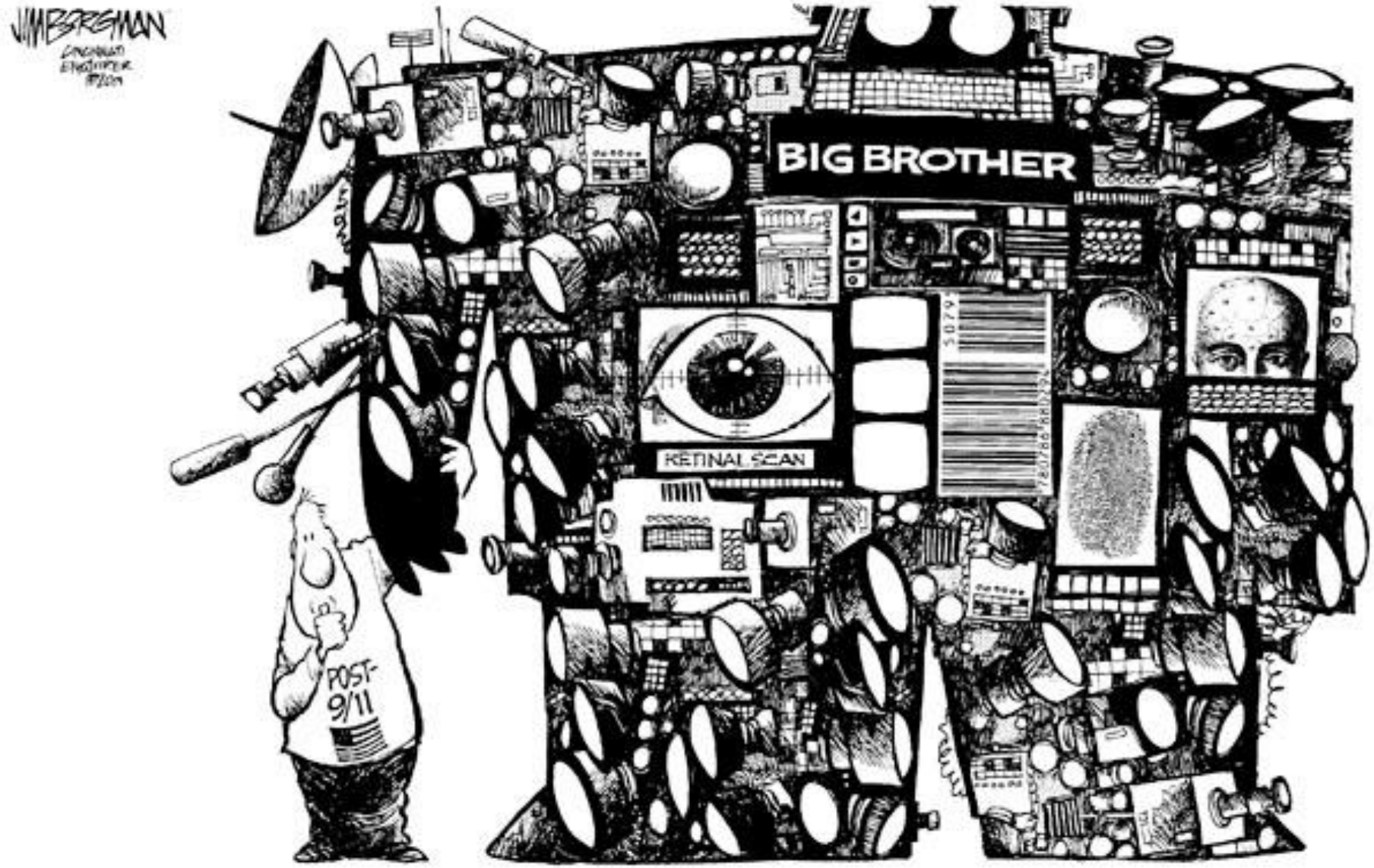
For storming the US Capitol on Jan 6, 2021

Recognition with Noisy & Incomplete Data



https://www.iarpa.gov/index.php?option=com_content&view=article&id=1223:biometric-recognition-and-identification-at-altitude-and-range-briar&catid=296

Privacy



Take Home Message

- **Biometric ensures a *person is who he claims to be* and *not who he denies to be***
- **Drivers: Applications (Security, fraud, civil-ID, payment,…)**
- **Enablers: Matching algorithm, processor, memory & sensor (fingerprint reader/matcher embedded in a mobile costs ~$1)**
- **Challenge*: Recognize anyone, anywhere, anytime in real time***