

User Authentication

COMP 435
Fall 2017
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Authentication

- Something you know
- Something you have
- Something you are
- Something you do

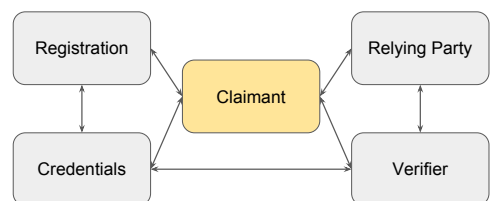
2

Biometrics: something you are or do

Measurement of some physical characteristic

3

Biometrics in Practice

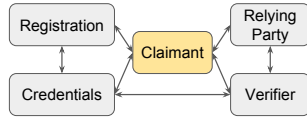


4

Biometrics in Practice

Registration

- Identification
- Sensing
- Digitization
- Feature (template) extraction

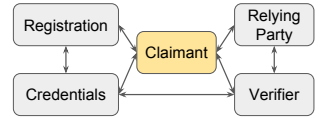


5

Biometrics in Practice

Credentials

- (ID, template)

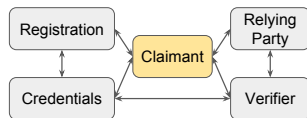


6

Biometrics in Practice

Relying Party

- Identification
 - Sensing
 - Digitization
 - Feature (template) extraction
-
- (ID, template)



7

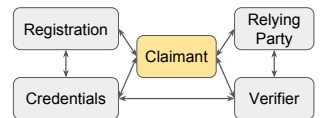
Biometrics in Practice

Verifier

Given (template, ID)

$template_{stored} := db(ID)$

$template_{stored} \stackrel{?}{=} template$



8

Verification Challenges

template_{stored} ≠ template_{presented}

9

Biometric Verification

probability density function, $f(s)$

Alice's template

template score, S

10

Biometric Verification

$f(s)$

Bob's template

Alice's template

False Positives possible

template score, S

11

Biometric Verification

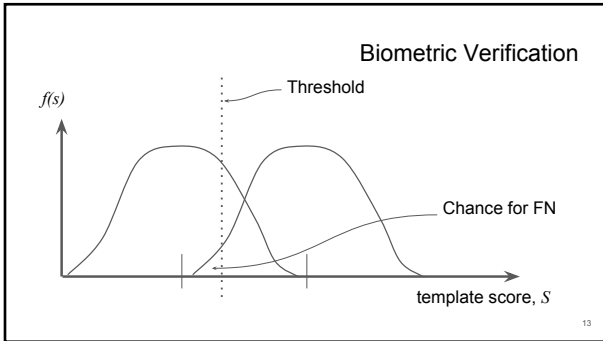
$f(s)$

Threshold

Chance for FP

template score, S

12



Incorrect Verification

False Positive: authenticating when you shouldn't
 False Negative: failing to authenticate when you should

14

Detection Procedures

	Is the claimant	Is not the claimant
Test is positive	True Positive	False Positive
Test is negative	False negative	True Negative

15

Incorrect Verification

Sensitivity: $TP / (TP + FN)$
 Specificity: $TN / (TN + FP)$
 Accuracy: $(TN + TP) / (TP + FN + TN + FP)$
 Prevalence: $(TP + FN) / (TP + FN + TN + FP)$

16

Incorrect Verification

Sensitivity:
 $TP / (TP + FN)$

Specificity:
 $TN / (TN + FP)$

Accuracy:
 $(TN + TP) / (TP + FN + TN + FP)$

Prevalence:
 $(TP + FN) / (TP + FN + TN + FP)$

TP Rate:
 sensitivity

FP Rate:
 $1 - \text{specificity}$

Positive Predictive Value:
 $TP / (TP + FP)$

Negative Predictive Value:
 $TN / (FN + TN)$

17

Pros and Cons of Biometrics

- Hard to forge
- Even harder to revoke
- Special equipment
- Single point of failure

18

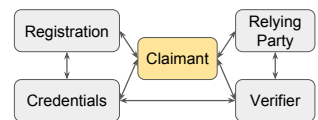
Identification vs Authentication with Biometrics: The Base Rate Fallacy

19

Authentication with Biometrics

Relying Party

- Identification
- Sensing
- Digitization
- Feature (template) extraction
- (ID, template)



20

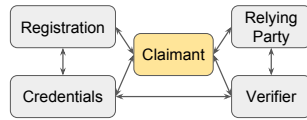
Authentication with Biometrics

Verifier

Given (template, ID)

$\text{template}_{\text{stored}} := \text{db}(\text{ID})$

$\text{template}_{\text{stored}} \stackrel{?}{=} \text{template}$



21

Identification with Biometrics

Identifier

Given (template)

$\text{template}_{\text{stored}} := \text{find_match}(\text{db}, \text{template})$

22

Identification with Biometrics

```
matches = set()
for (entry in DB)
    if (is_match(template_given, entry))
        matches.add(entry)
return matches
```

23

Base Rate

Rate of incident in a population

24

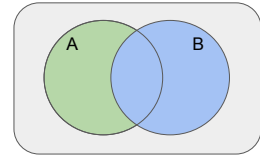
False Positives and the Base Rate

If the rate of incidence is low compared to the rate of false positive detection, most of the "detected" results returned will be false.

25

Conditional Probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$
$$= \frac{P(B|A)P(A)}{P(B)}$$



Conditional Probability

$$P(\text{true ID} | \text{match}) = \frac{P(\text{match} | \text{true ID})P(\text{true ID})}{P(\text{match})}$$

$$P(\text{true ID}) = .0001$$

Base rate

$$P(\text{match} | \text{not true ID}) = .01$$

FP rate

$$P(\text{true ID} | \text{match}) = .0099$$

Given a match, this is the chance it is the right person!

28

Threat

An ID returned by the identifier is more likely to be the wrong ID than to be the right ID.