

EEE-6561 Fundamentals of Biometric Identification

January 19th, 2018

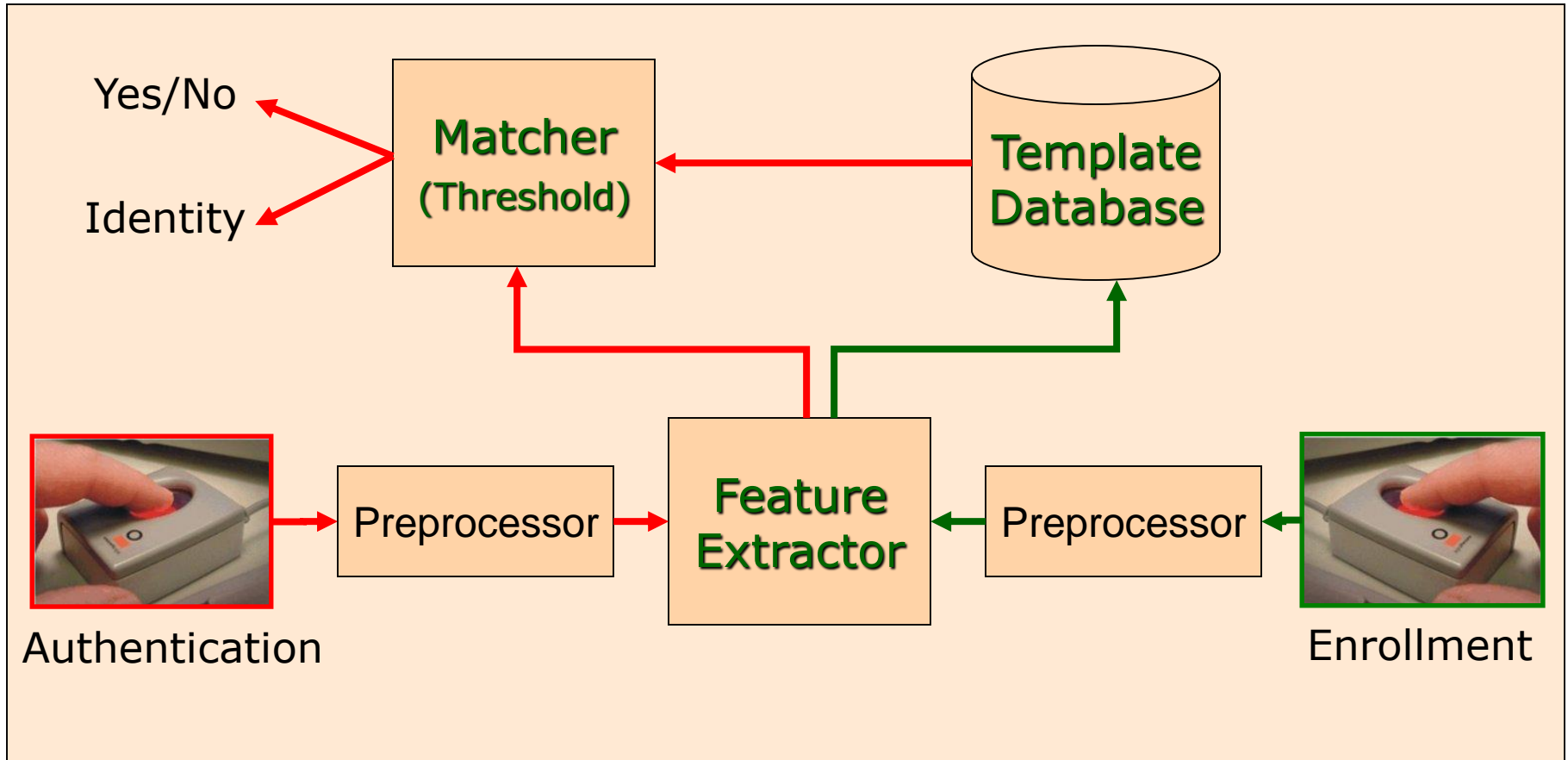
Lecture #4 Biometric System Evaluation and Design

Damon L. Woodard, Ph.D.

Dept. of Electrical and Computer Engineering

dwoodard@ece.ufl.edu

Biometrics: A Pattern Recognition System



- False accept rate (**FAR/FMR**): Proportion of imposters accepted
- False reject rate (**FRR/FNMR**): Proportion of genuine users rejected
- Failure to enroll rate (**FTE**)
- Failure to acquire rate (**FTA**)

Error Rates

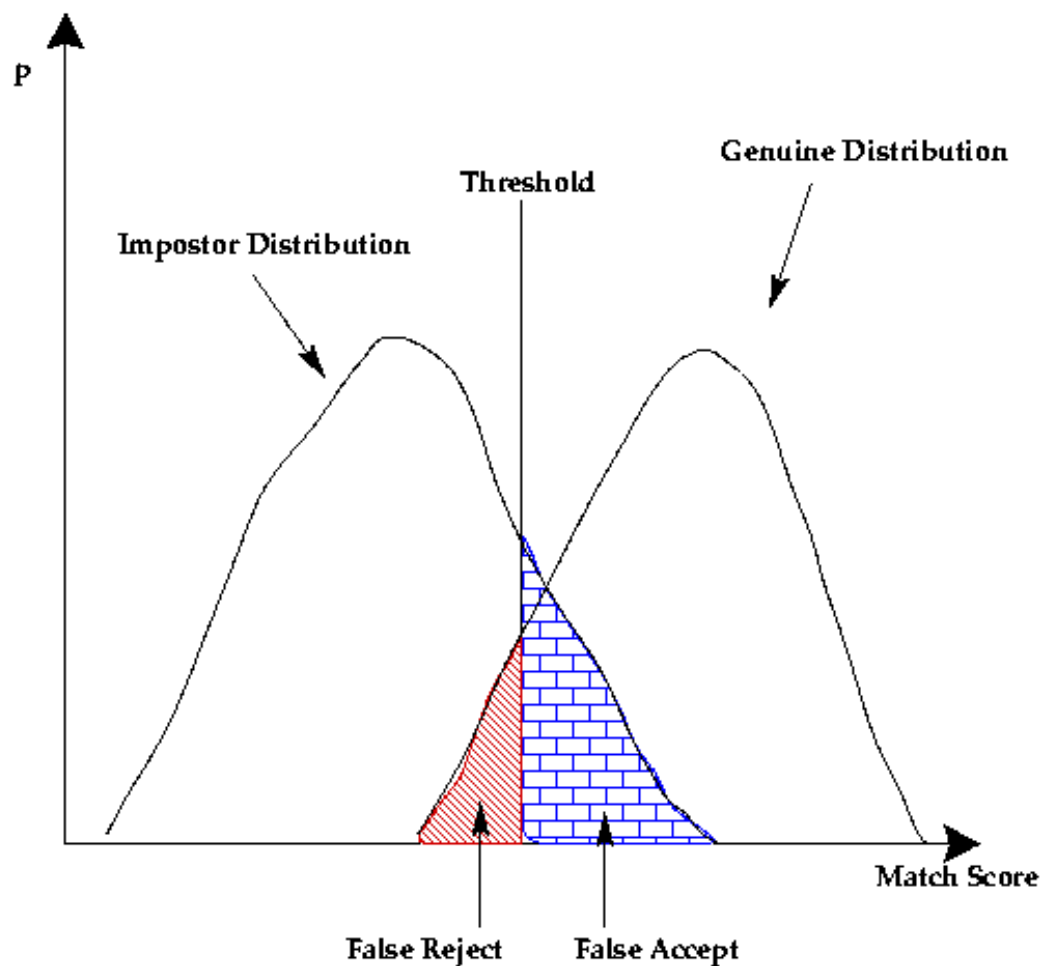
False Accept Rate (FAR):

- The fraction (or percentage) of impostor scores greater than the threshold
- It represents the probability that an impostor will be incorrectly matched with a certain identity at a given threshold
- A low FAR is required in high secure systems such as nuclear facilities

False Reject Rate (FRR):

- The fraction (or percentage) of genuine scores lower than the threshold
- It represents the probability that a genuine user will be incorrectly rejected when claiming his/her true identity
- A low FRR is required in systems which focus on user convenience

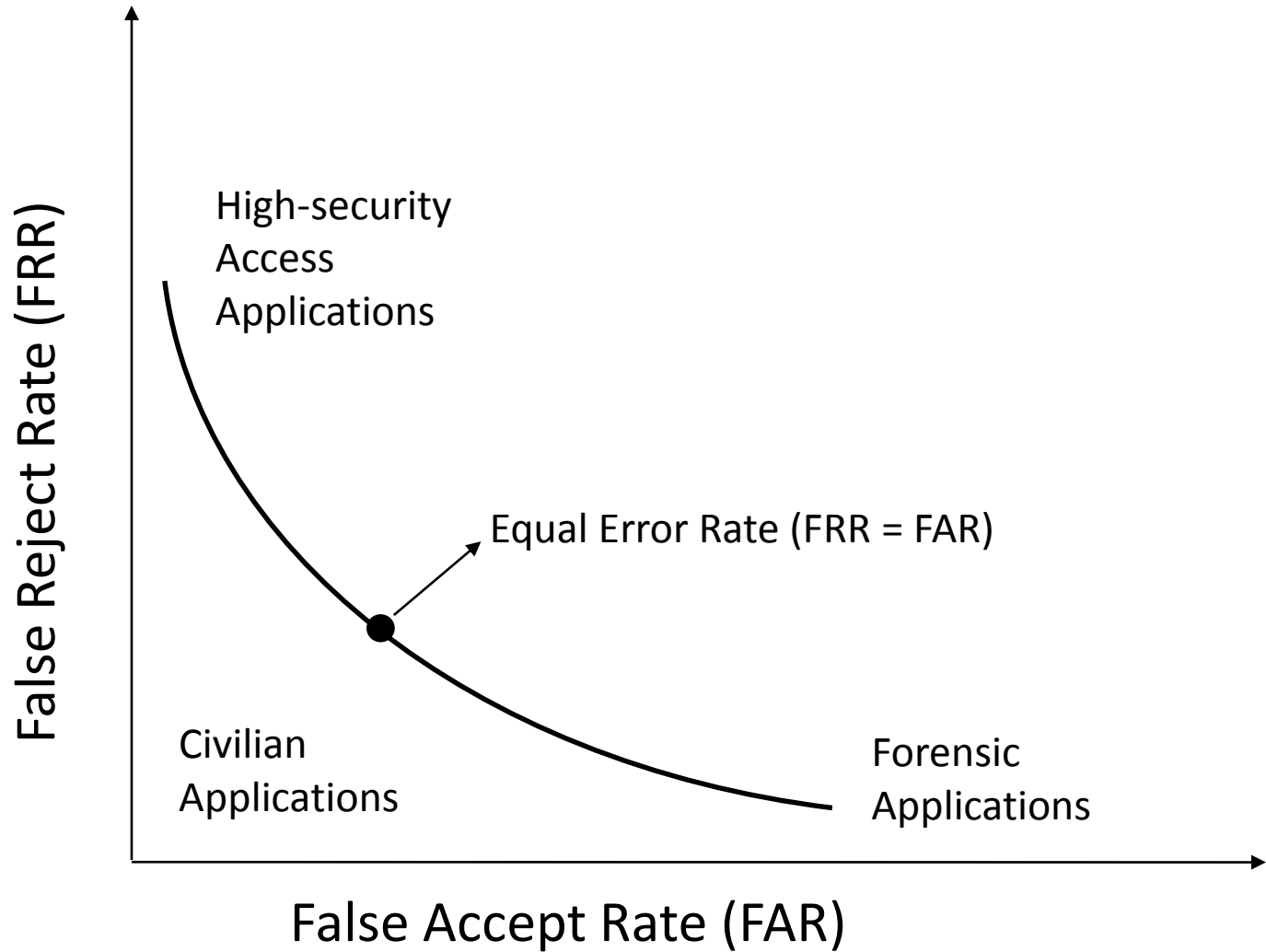
Match Score Distributions



Performance Curves

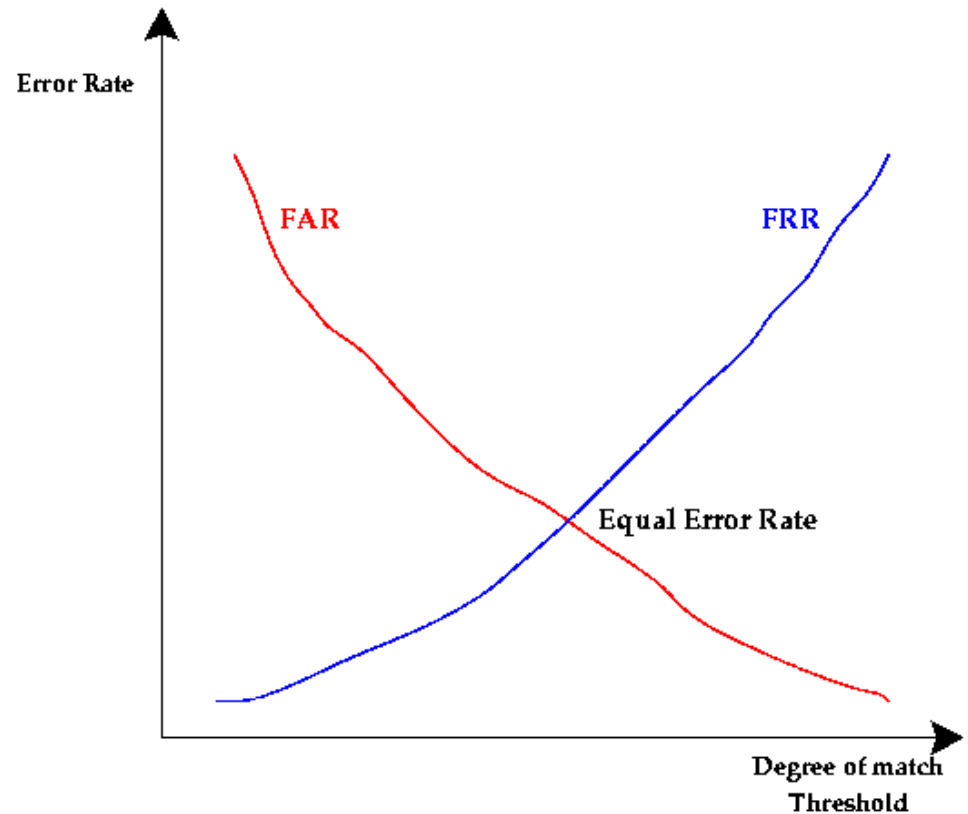
- The FAR and FRR values vary with the threshold
- A Receiver Operating Characteristic (ROC) curve plots the FRR against FAR
- It can also plot the Genuine Accept Rate (GAR) against FAR

ROC Curves



Equal Error Rate

- EER is the point where $FRR = FAR$
- Systems having lower EER are preferred



Area Under the Curve

0.9 - 1.0 = excellent
0.8 - 0.9 = good
0.7 - 0.8 = fair
0.6 - 0.7 = poor
0.5 - 0.6 = fail

***use when you can't
pick a threshold**

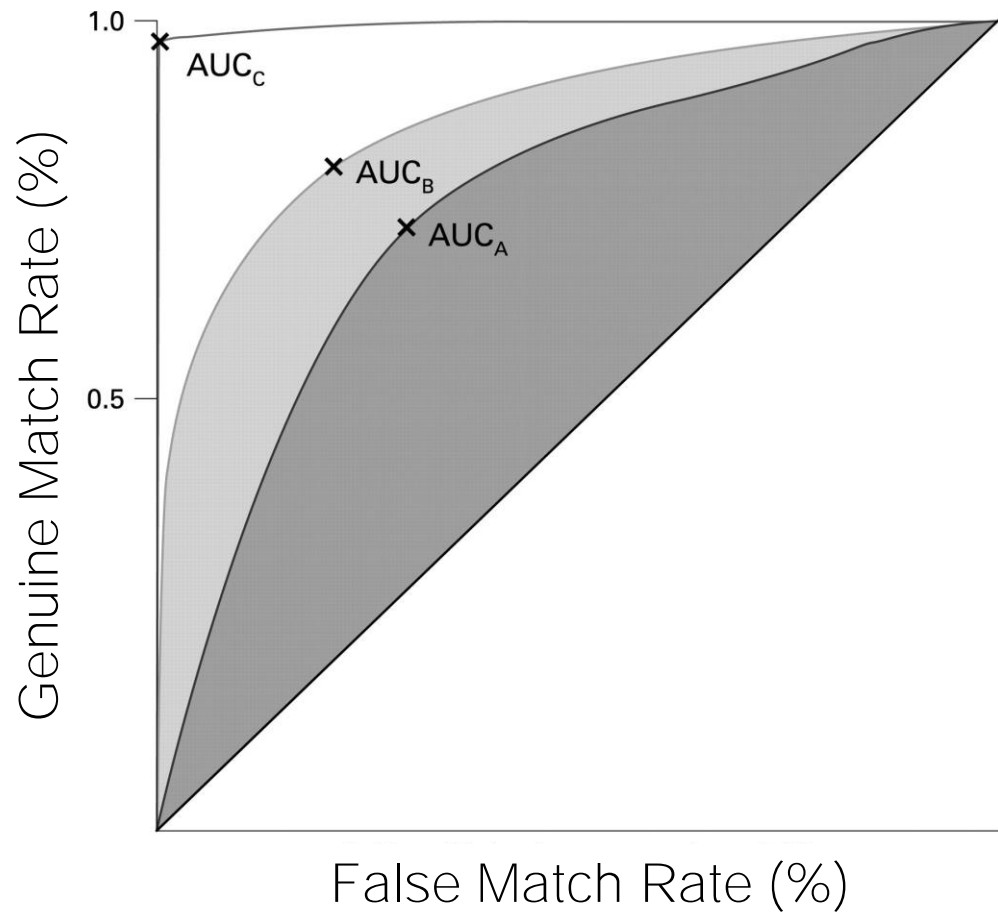


Image adapted from figure appearing in the Journal of Clinical Pathology

d' value

- The **d-prime value** (d') measures the separation between the means of the genuine and impostor probability distributions in standard deviation units and is defined as.

$$d' = \frac{\sqrt{2} |\mu_1 - \mu_0|}{\sqrt{\sigma_1^2 + \sigma_0^2}},$$

- where μ_1 (μ_0) and σ_1 (σ_0) are the mean and standard deviation, respectively, of the genuine (impostor) score distributions
- A higher d-prime value indicates better performance

Four Categories of Users

- *Sheep* represent users whose biometric feature sets are very distinctive and exhibit **low intra-class variations**. Therefore, these users are expected to have low false accept and false reject errors.
- *Goats* refer to users who are prone to false rejects. The biometric feature sets of such users typically exhibit **large intra-class variations**.
- *Lambs* are users whose biometric feature set overlaps extensively with those of other individuals. The biometric feature sets of these users have **high inter-user similarity**. The false accept rate associated with these users is typically high.
- *Wolves* indicate individuals who are successful in deliberately manipulating their biometric trait in order to impersonate legitimately enrolled users of a system; An **adversary attack**; increase FAR (e.g., A person forges the signature of another user or mimicking someone else's voice)

Questions?

Slide Credits

Slides include some by authors of Introduction to Biometrics textbook