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Optimal Decision Level Acceptance Rules for Multimodal Biometric Systems

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Decisions in Multimodal Systems

- Decision level integration: simple and appealing.
- Assumptions:
 - N modalities.
 - Known false accept/reject rates for each modality.
 - Hypothesized imposter probability.
 - User verification attempted at all N devices.
- Determine the *least K (number of accepts)* out of N that maximizes correct performance.
 - Different from simple majority.
 - Weighted by the cost of misclassification.

Example (1)

- Number of devices: $N = 3$
- Imposter probability: $\theta = 0.01$
- *Device 1: Fingerprint, Device 2: Face, Device 3: Voice*
- $FAR_1 = 0.002, FAR_2 = 0.05, FAR_3 = 0.05$
- $FRR_1 = 0.002, FRR_2 = 0.15, FRR_3 = 0.1$
- Cost of accepting an imposter: $C_1 = \$1000$
- Cost of rejecting a genuine user: $C_2 = \$10$

K	PCD	Expected Cost of misclassification (\$)
1	0.9989	0.9933
2	0.9846	0.1797
3	0.7658	2.3416

Example (2)

- Number of devices: $N = 3$
- Imposter probability: $\theta = 0.01$
- Device 1: Fingerprint, Device 2: Face, Device 3: Voice
- $FAR1 = 0.002$, $FAR2 = 0.001$, $FAR3 = 0.035$
- $FRR1 = 0.002$, $FRR2 = 0.2$, $FRR3 = 0.15$
- Cost of accepting an imposter: $C1 = \$1000$
- Cost of rejecting a genuine user: $C2 = \$10$

K	PCD	Expected Cost of misclassification (\$)
1	0.999	0.3795
2	0.969	0.3038
3	0.681	3.1814

Choosing K

➤ Criterion:

- Maximize the *probability of correct decision (PCD)*, assuming that θ represents the probability of an imposter.

$$\begin{aligned} PCD &= (1 - \alpha_S)\theta + (1 - \beta_S)(1 - \theta) \\ &= (1 - \beta_S) + \theta(\beta_S - \alpha_S) \end{aligned}$$

- $X_i = 1$ if D_i falsely accepts, 0 otherwise.
- $Y_i = 1$ if D_i falsely rejects, 0 otherwise.

$$\alpha_S = P\left[\sum_{i=1}^N X_i \geq K\right]$$

$$\beta_S = P\left[\sum_{i=1}^N Y_i > N - K\right]$$