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Mobile Biometrics

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<div align="center">Homework 3 - Evaluating Biometric Systems</div>

SCORE DISTRIBUTIONS AND INTERPRETATION

a) By plotting both genuine and impostor scores, it is possible to visualize the separation between them or how much they overlap. By visually comparing the distributions we can identify the separation between genuine and impostor scores, assess potential false positives and false negatives, and select a better threshold to minimize these errors.

b) The d-prime value represents the distance between the means of the genuine and impostor scores divided by their standard deviations. A higher d-prime represents a larger gap between genuine and impostor scores, meaning better system performance with a higher accuracy, smaller overlap, and fewer errors. The d-prime is also independent from the threshold, providing a better comparison across systems.

THRESHOLDING AND PERFORMANCE METRICS

a) Evaluating false positive rate, false negative rate, and true positive rate for a range of different threshold values might provide more insights into the acceptance and rejection errors at each point. Some of these insights can be analyzing the sensitivity to threshold changes, evaluating system robustness, and choosing better thresholds according to specific security or usability concerns.

b) A threshold needs to be able to balance false positive rates and false negative rates, meaning a balance between security and usability. A lower rate in false acceptances is

ideal for high-security systems, where the main concern revolves around never allowing access to impostors, like a mobile banking app or even a phone's system settings.

DET AND ROC CURVES

a) The Detection Error Tradeoff (DET) curve plots false positive rates vs. false negative rates, while Receiver Operating Characteristic (ROC) curve plots true positive rates vs. false positive rates. The DET curve contains the EER, which when lower represents better performance. The area under the ROC curve showcases more separation between genuine and impostor scores when closer to 1.0 (perfect model).

b) The Equal Error Rate (EER) represents the point where false positive and false negative rates are equal in the DET curve. A lower EER represents better system performance, showing that both false positives and negatives are not frequent. The EER can compare different systems without specifying a threshold.

SYSTEM COMPARISON

a) System C has the best performance since it has the highest d-prime, lowest EER, and ROC closest to 1.0. After C, system B has the second best performance, and system A is last. System C has 0 EER and ROC's area under the curve closer to 1.0 because the genuine and impostor scores are fully separated with no overlap. For systems A and B, while both have overlap of scores, system B's d-prime value is still higher so its scores are better separated than in system A. Following that same logic, system B has a lower EER and area under ROC that's closer to 1.0.
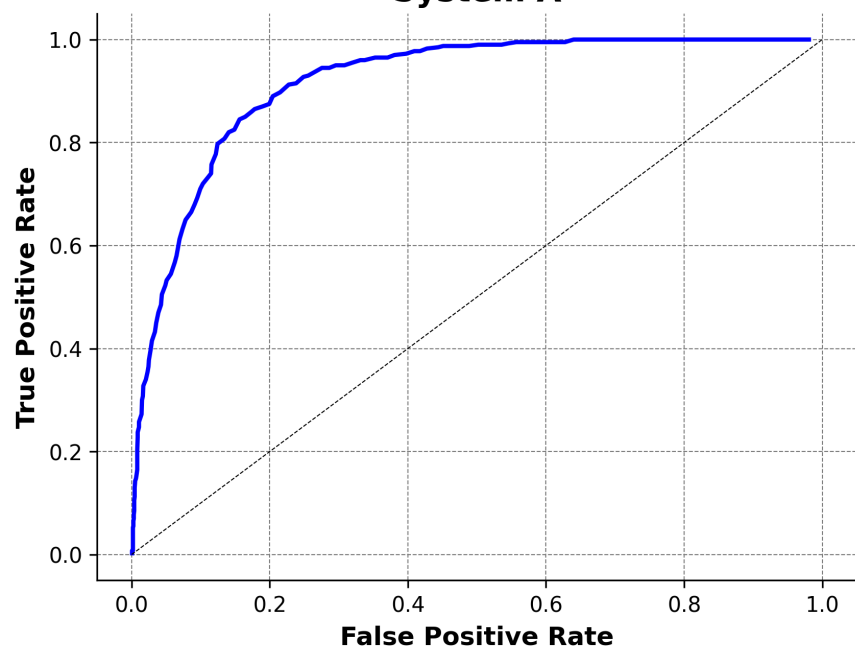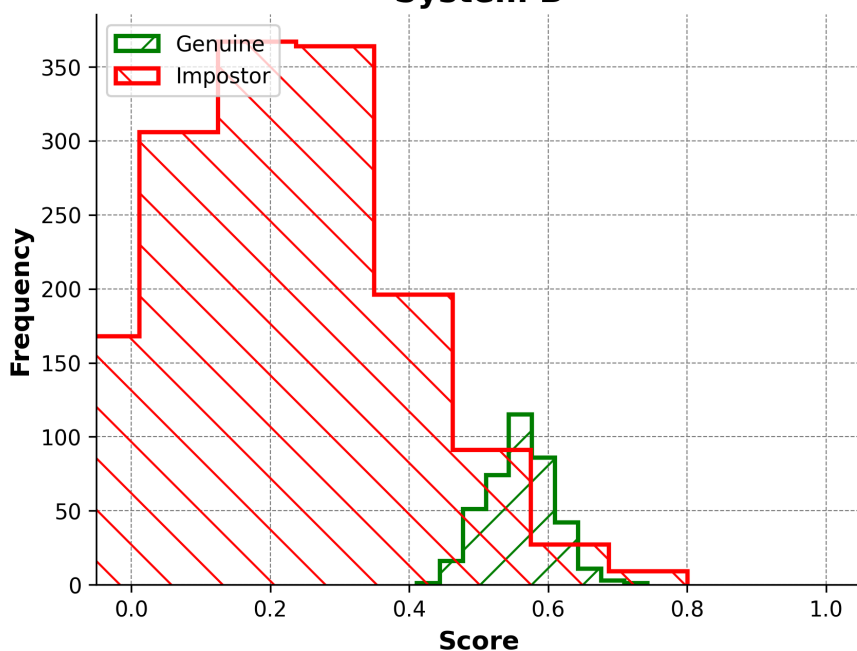
Score Distribution Plot
d-prime= 1.95
System A
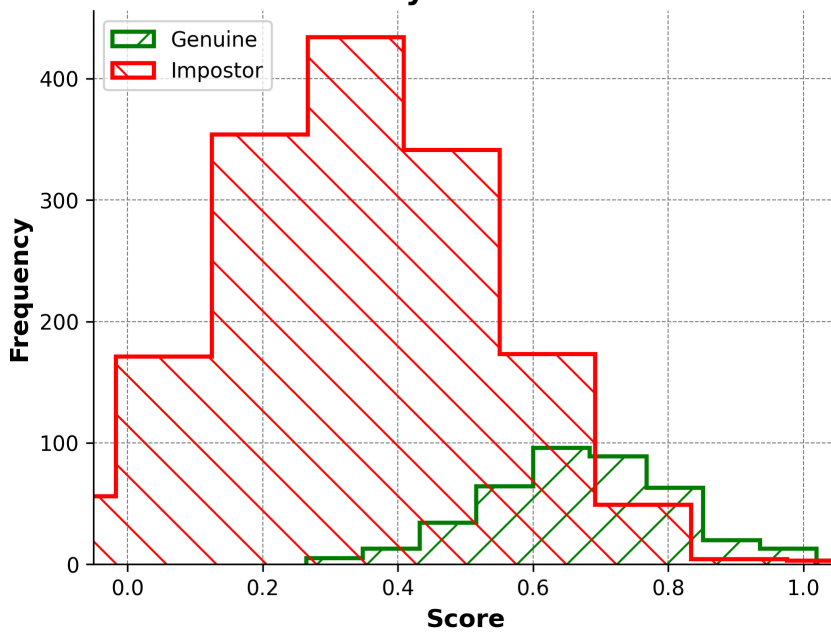
Detection Error Tradeoff Curve
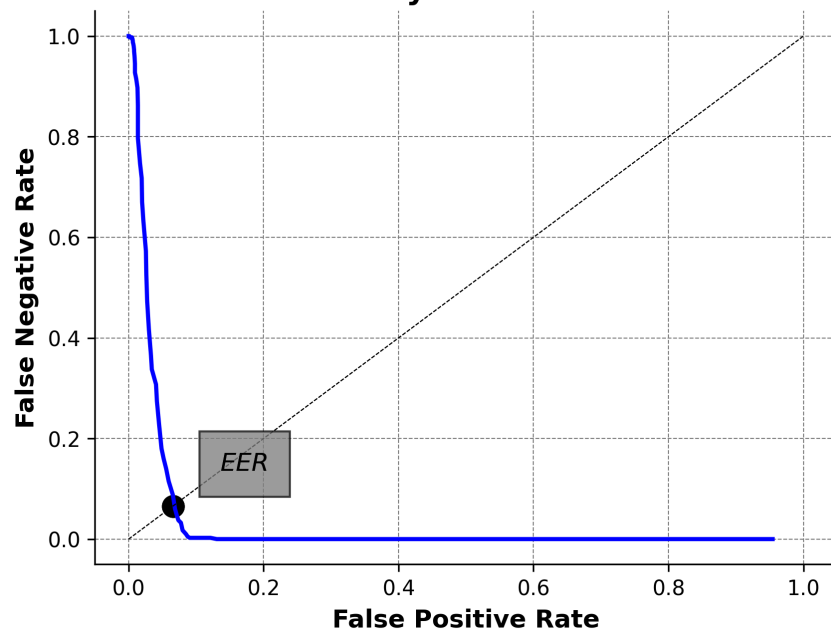**EER = 0.14875**
System A
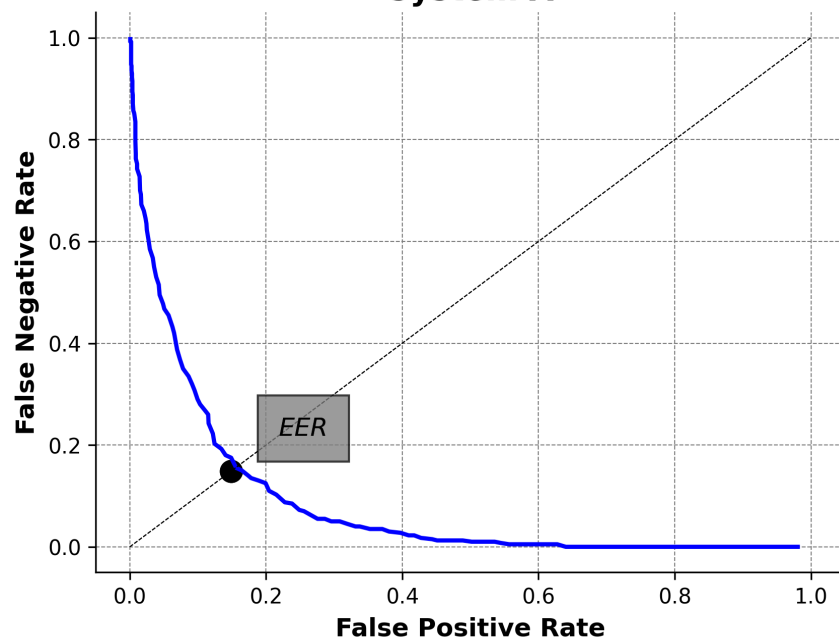
Receiver Operating Characteristic Curve
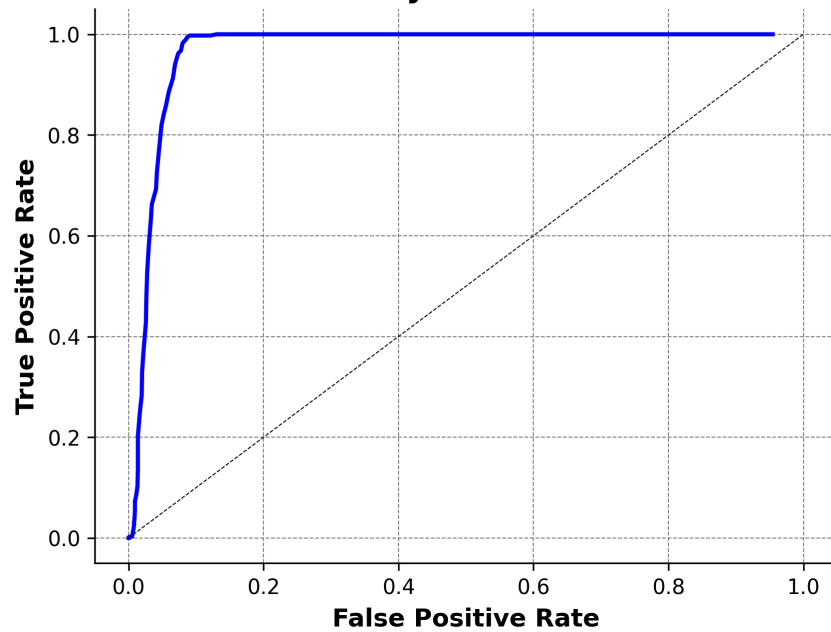## Area under Curve = 0.89725
System A

Score Distribution Plot
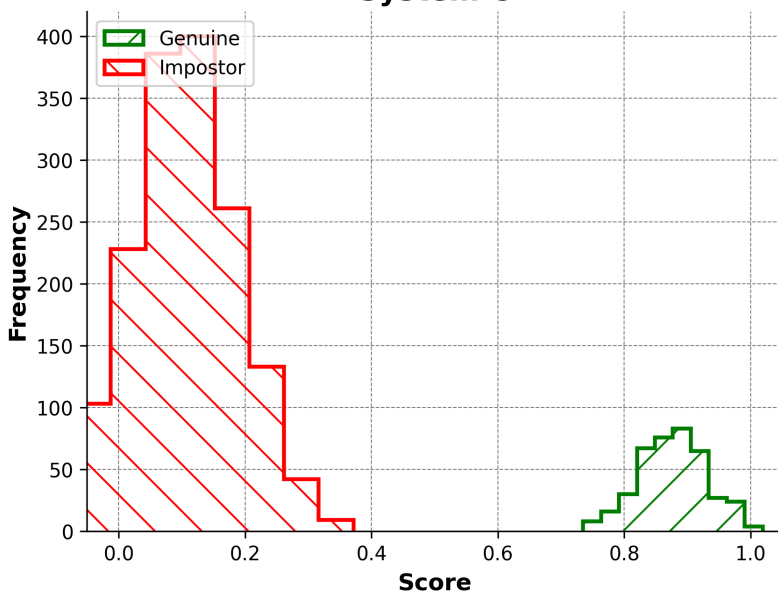## d-prime= 2.67
System B

Detection Error Tradeoff Curve
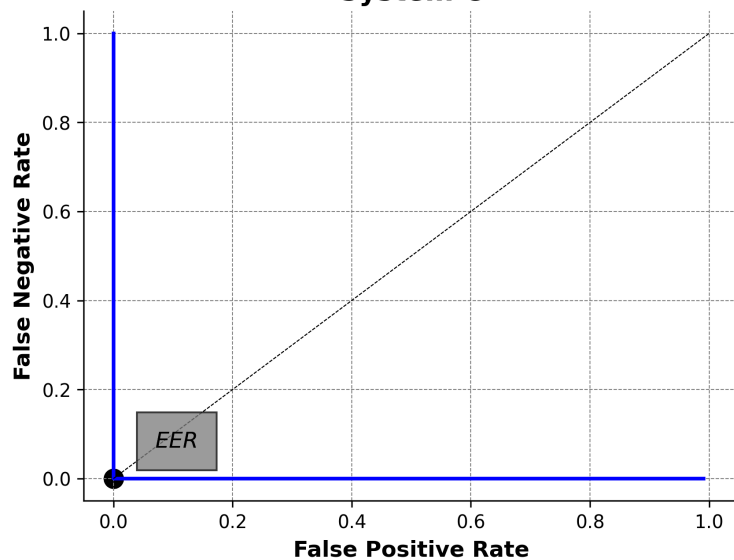## EER = 0.06562
System B

Receiver Operating Characteristic Curve
Area under Curve = 0.92223
System B

Score Distribution Plot
d-prime= 10.87
System C

Detection Error Tradeoff Curve
EER = 0.00000
System C

Receiver Operating Characteristic Curve
Area under Curve = 0.99062
System C