Signature Embedding: Deep Metric Learning for Writer Independent Offline Signature Verification

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Objective

The handwritten signature is widely employed and accepted as a proof of a person's identity. In everyday situations it is usually verified only casually, if at all. To raise authenticity, the need for automatic signature verification systems arises. We propose a new approach to writer independent offline signature verification.

Approach

We trained a Deep Neural Network (DNN) to embed signatures into high-dimensional space.

- similar (genuine) signatures are embedded closer together than dissimilar (forged) signatures
- the Euclidean distance is used as a similarity metric
- based on two signatures' distance, a soft classification decision is derived as a log-likelihood ratio

Our DNN is trained by embedding triplets of genuine and forged signatures. The loss function aims for minimizing the distance between genuine signatures, while maximizing their distance to the forged signature.

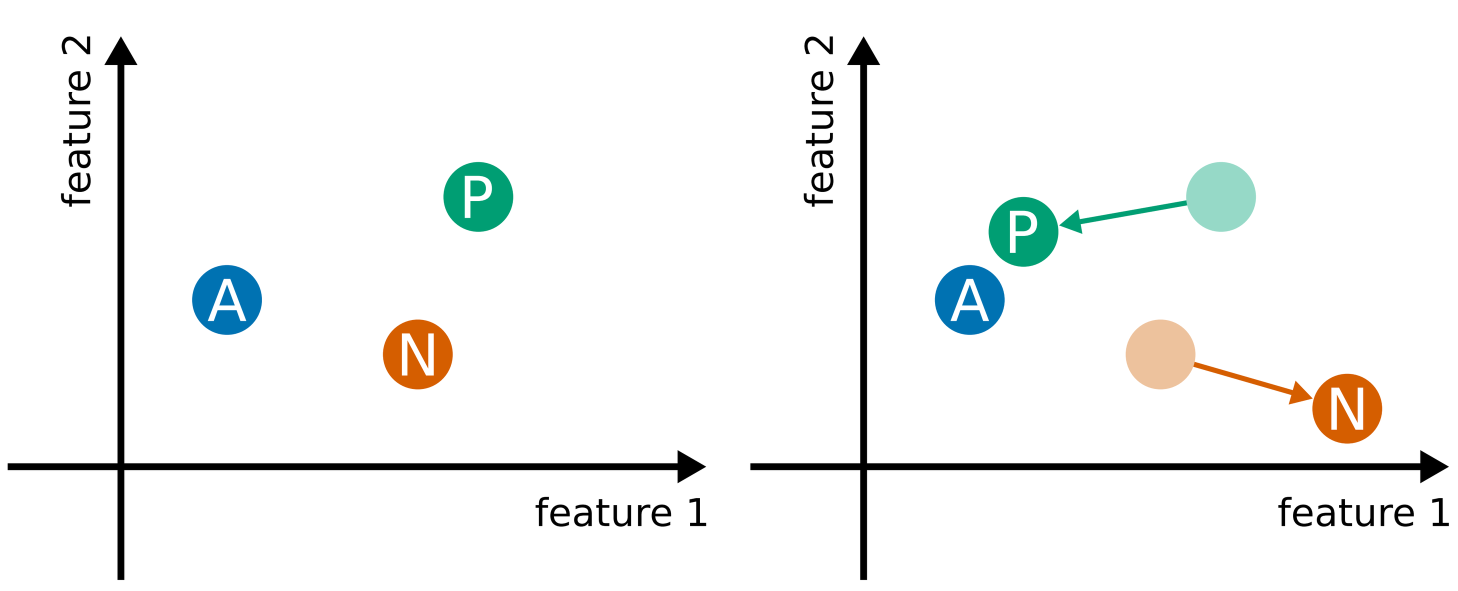

Figure 3: Over time, the DNN learns to embed genuine signatures (A, P) closer together, and forged signatures (N) further away

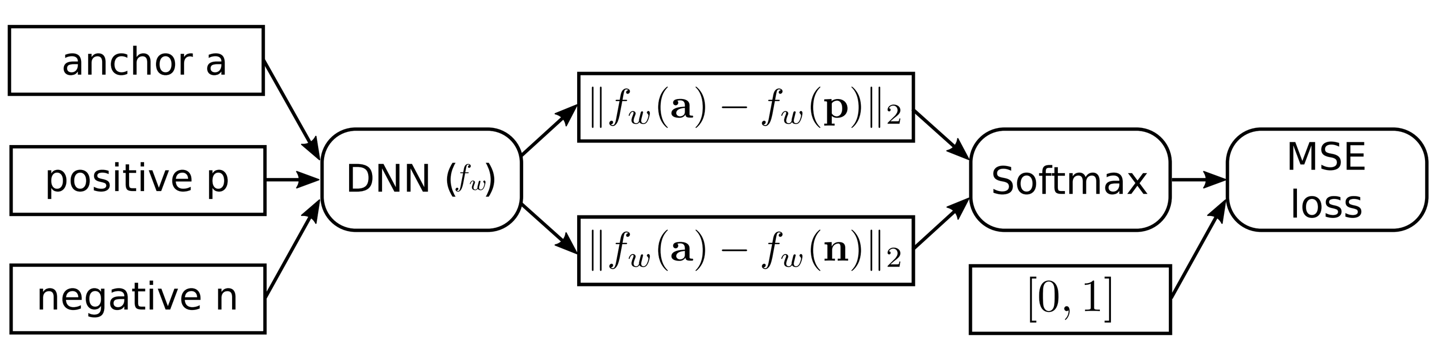

Figure 4: The loss calculation is based on comparing three signatures' (two genuine, one forged) relative distances at a time

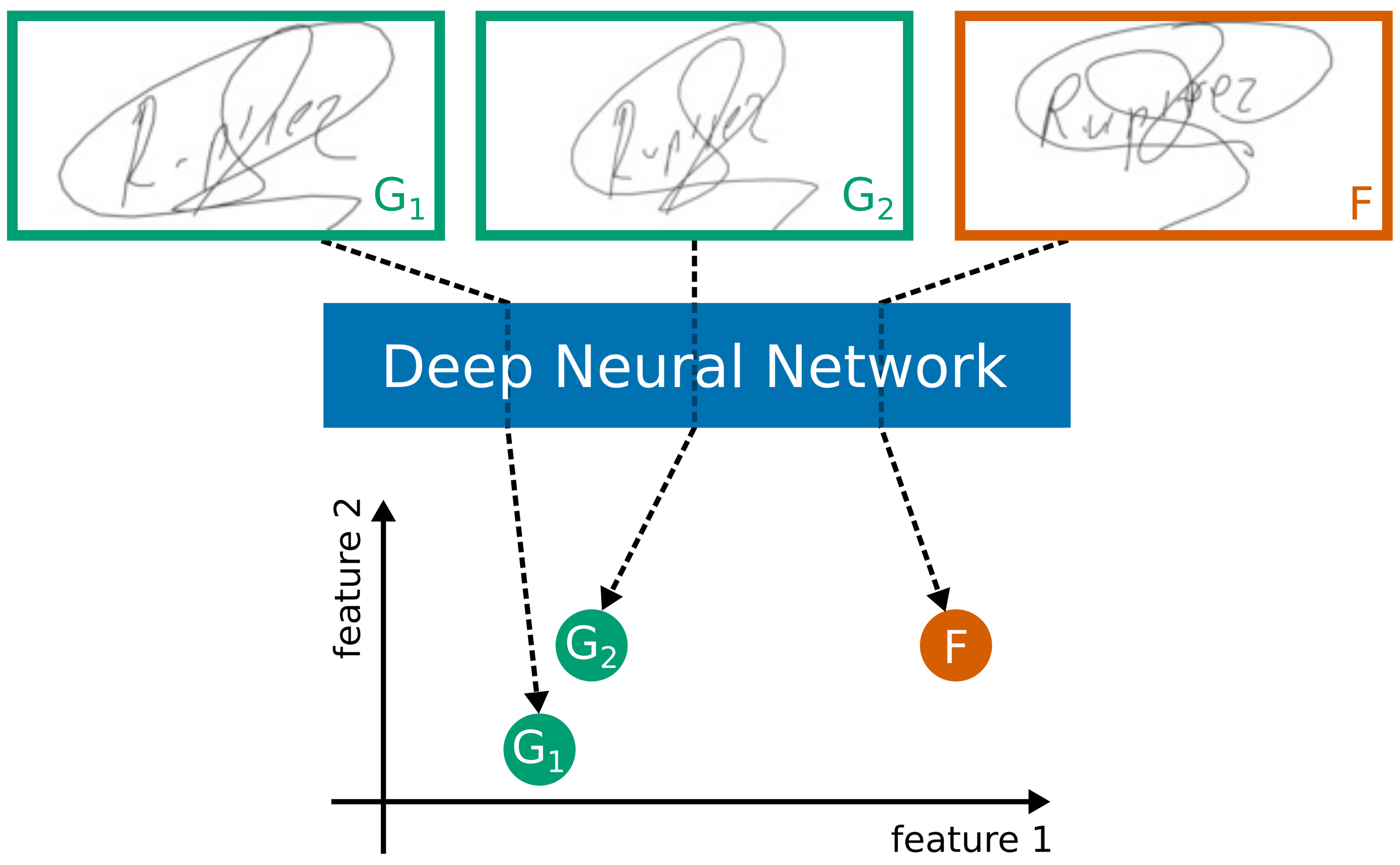

Figure 1: A Deep Neural Network embeds signatures into Euclidean space

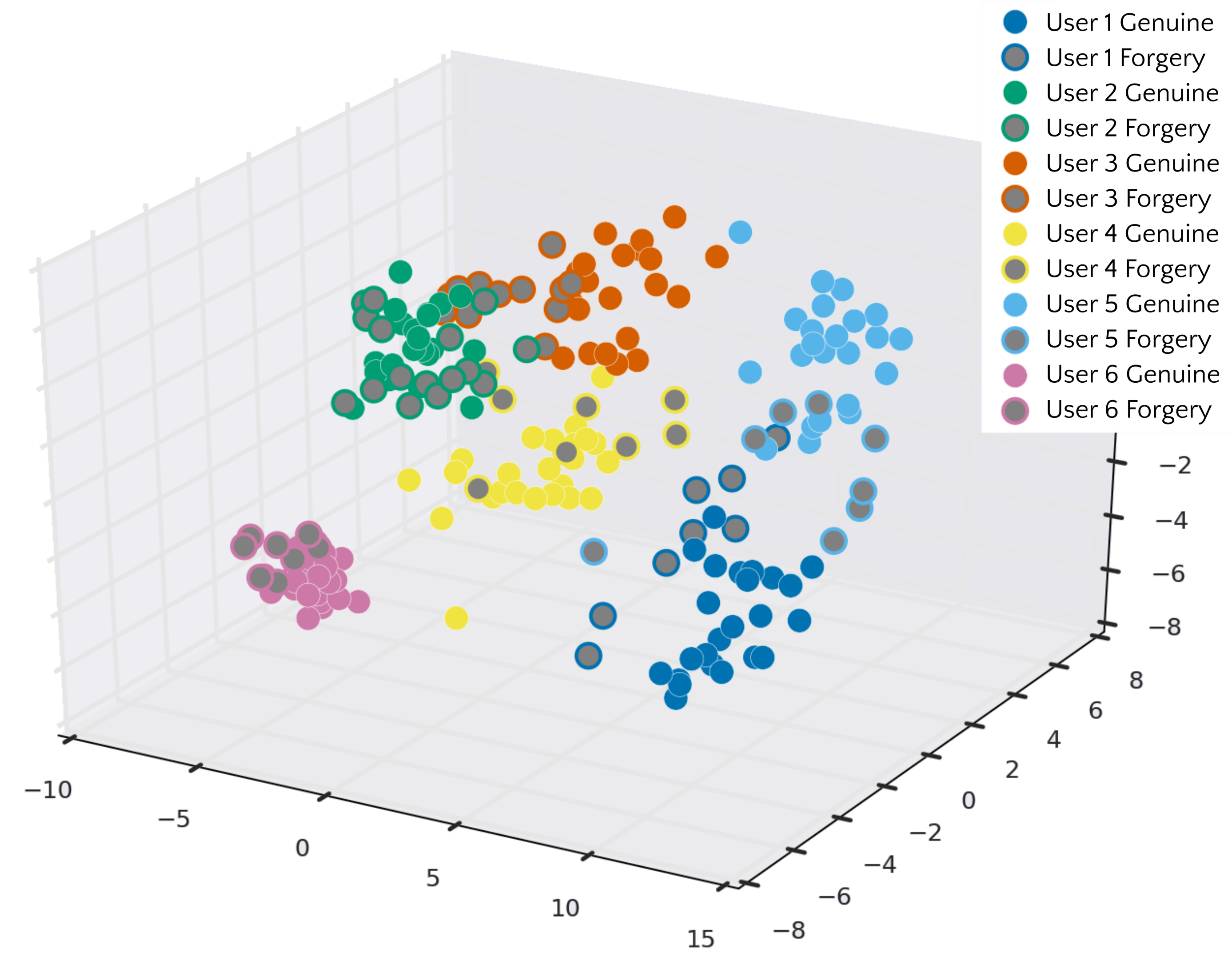

Figure 2: Embedded signatures form clusters based on their similarity

Results

We evaluated our approach based on the ICDAR SigWiComp 2013 challenge on offline signature verification. Our system outperforms previous systems in near to all respects.

	Accuracy (%)	C_{llr}^{min}
SigWiComp'13 Dutch Signatures	81.76	0.653 741
SigWiComp'13 Japanese Signatures	93.39	0.316 642

The results for both datasets were obtainted from the same model. As the model was trained on latin script signatures only, it's performance on Japanese script signatures shows that our approach generalizes very well.

Contact

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