# A Deep Adversarial Framework for Visually Explainable Periocular Recognition

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# Visual Explainability

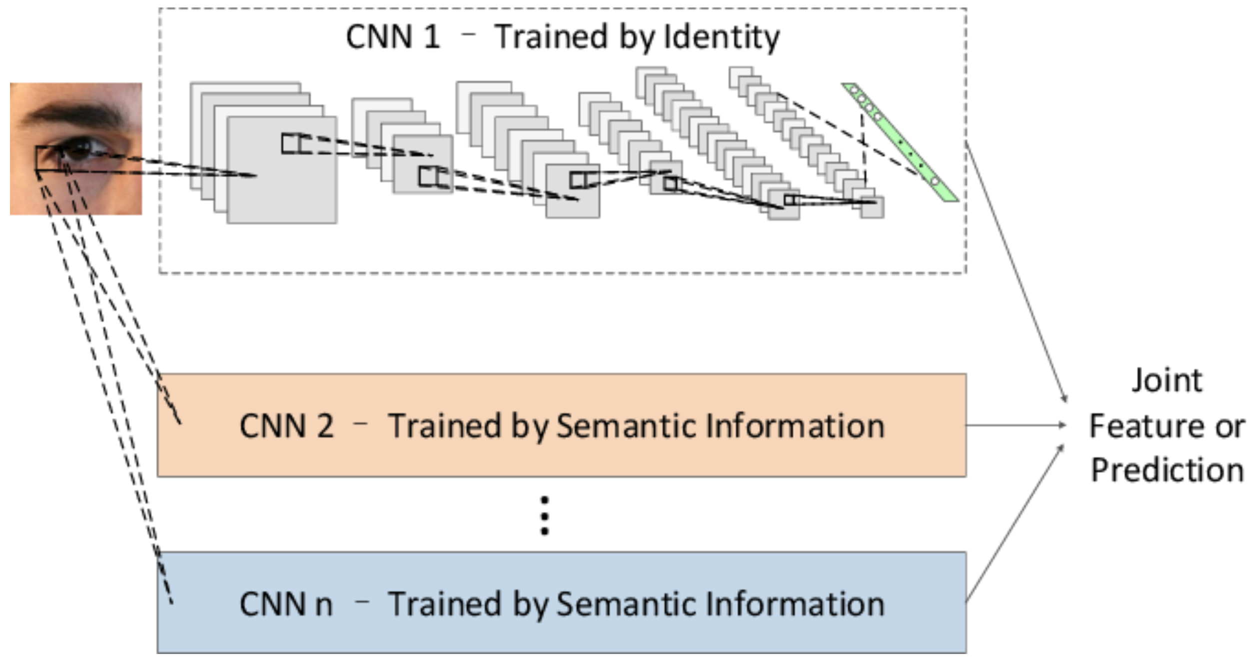
- ✓ Immediately **understandable**
- ✓ Context-aware

**Synthetic images increase data variability, attenuate differences in phase and enable component-by-component matching**

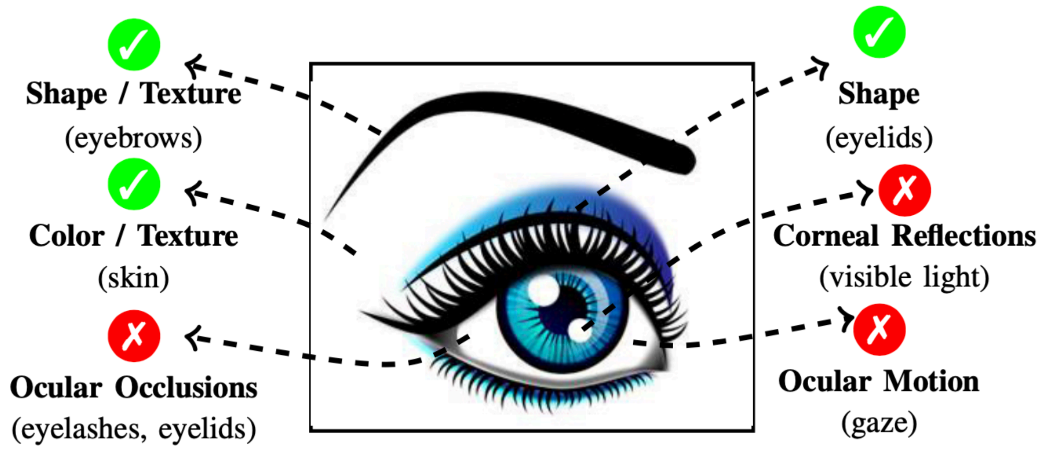

Results attained by the proposed solution.

# Related Work

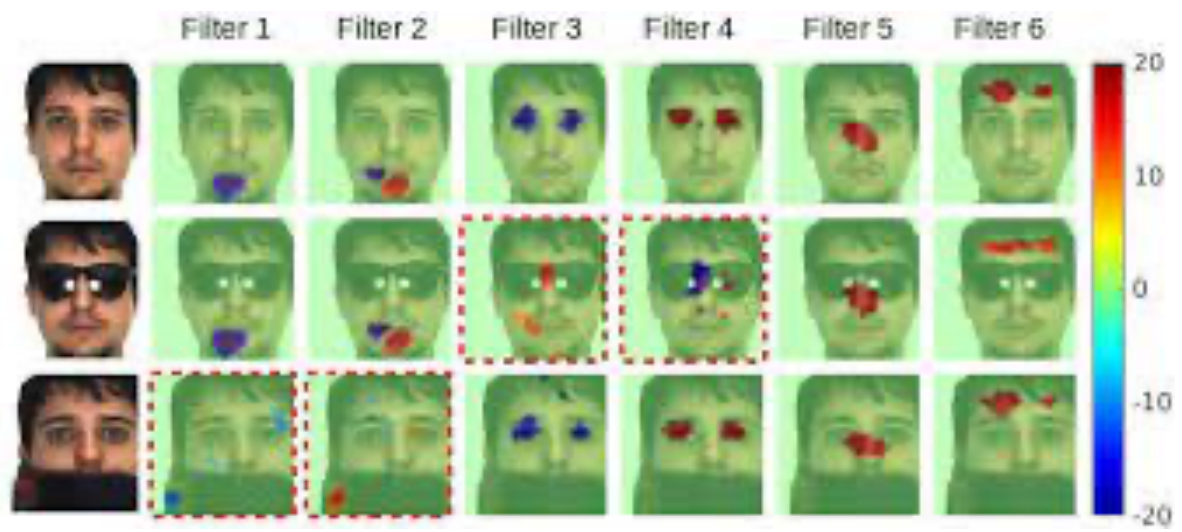
## Periocular / Biometric Recognition



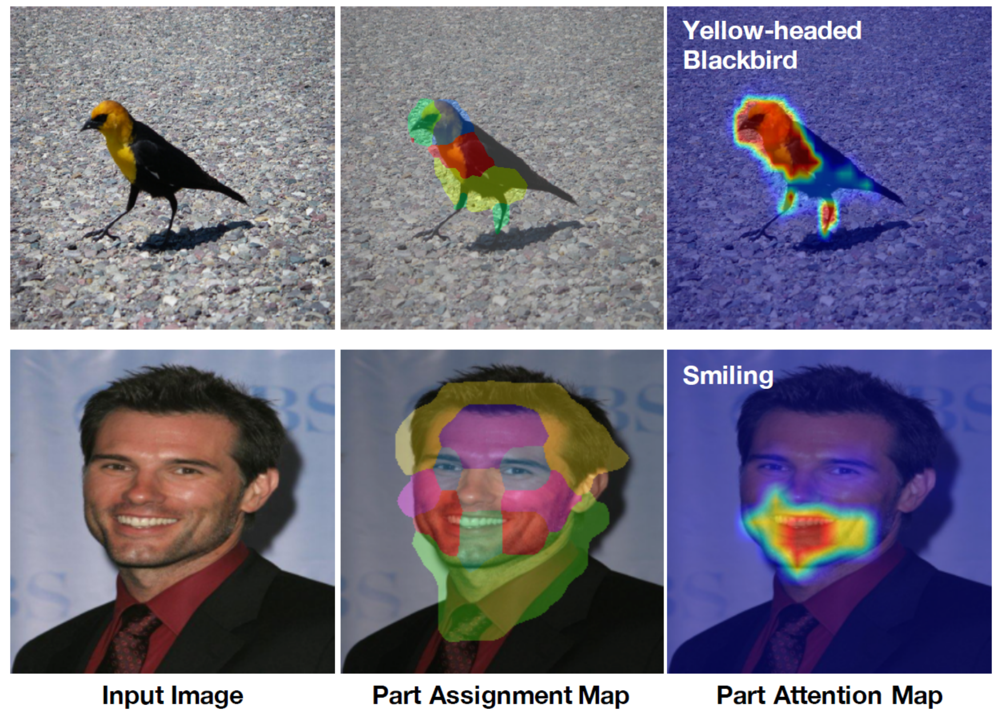

Zhao and Kumar, 2017




Proença and Neves, 2018

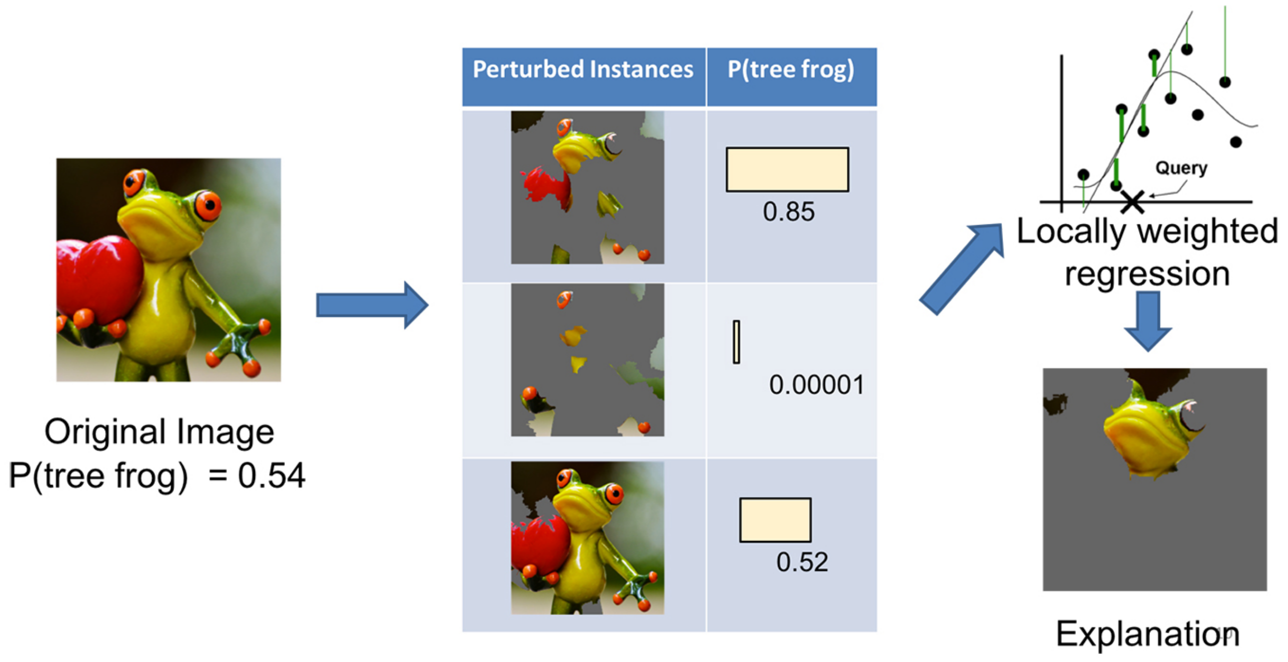



Yin *et al.*, 2019



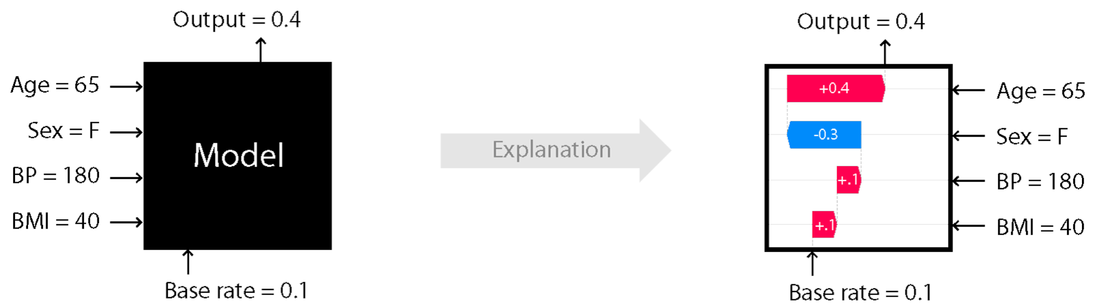

Huang and Li, 2020

## ML Explainability

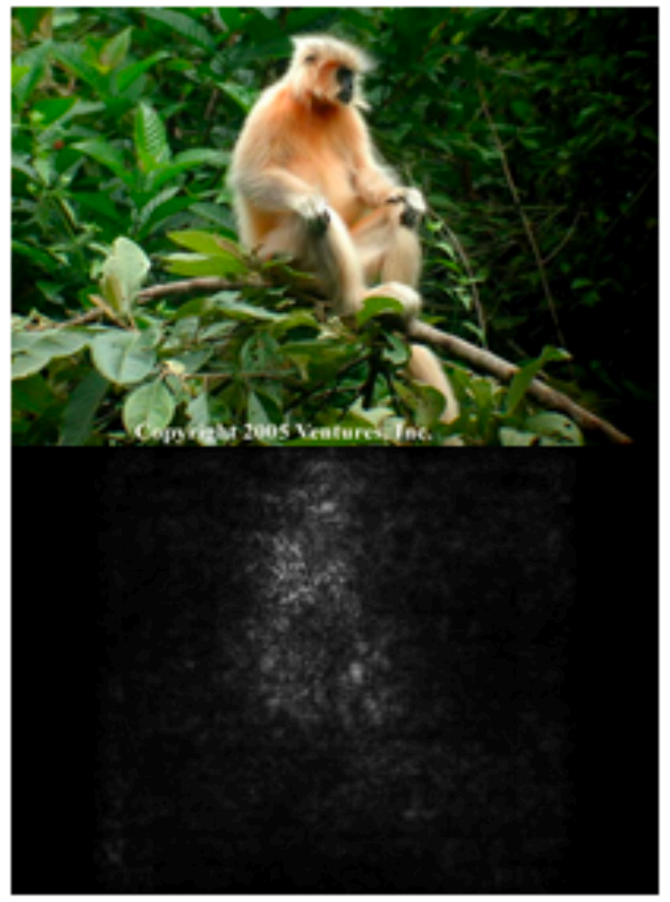



Ribeiro *et al.*, 2016

SHAP



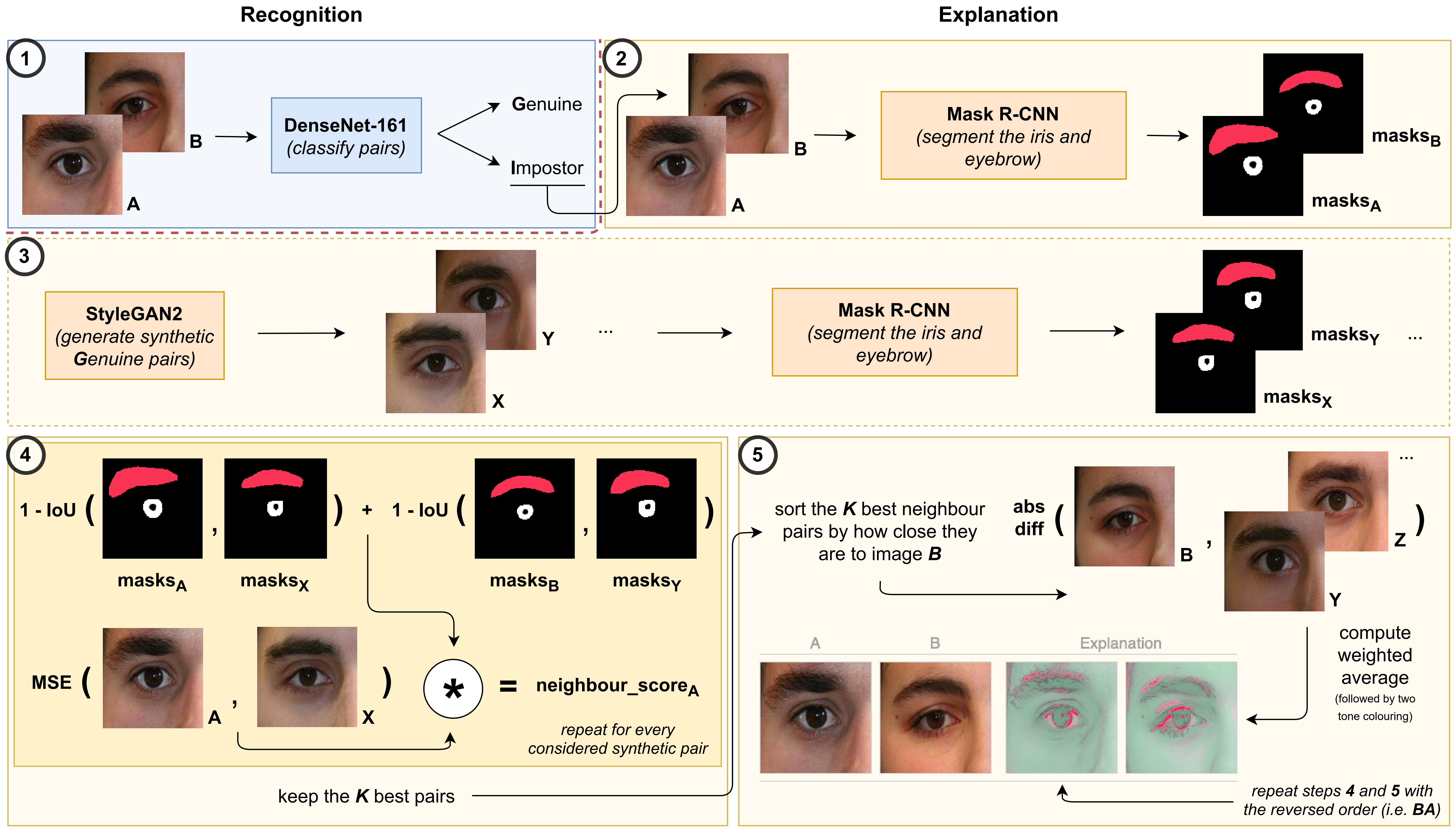

Lundberg and Lee, 2017



Simonyan *et al.*, 2017

# Proposed Method

- ✓ **Recognition** and **Explanation** phases
- ✓ **Modular** architecture
- ✓ Search amongst a **high quality synthetic dataset** of "Genuine" samples, for optimal matches

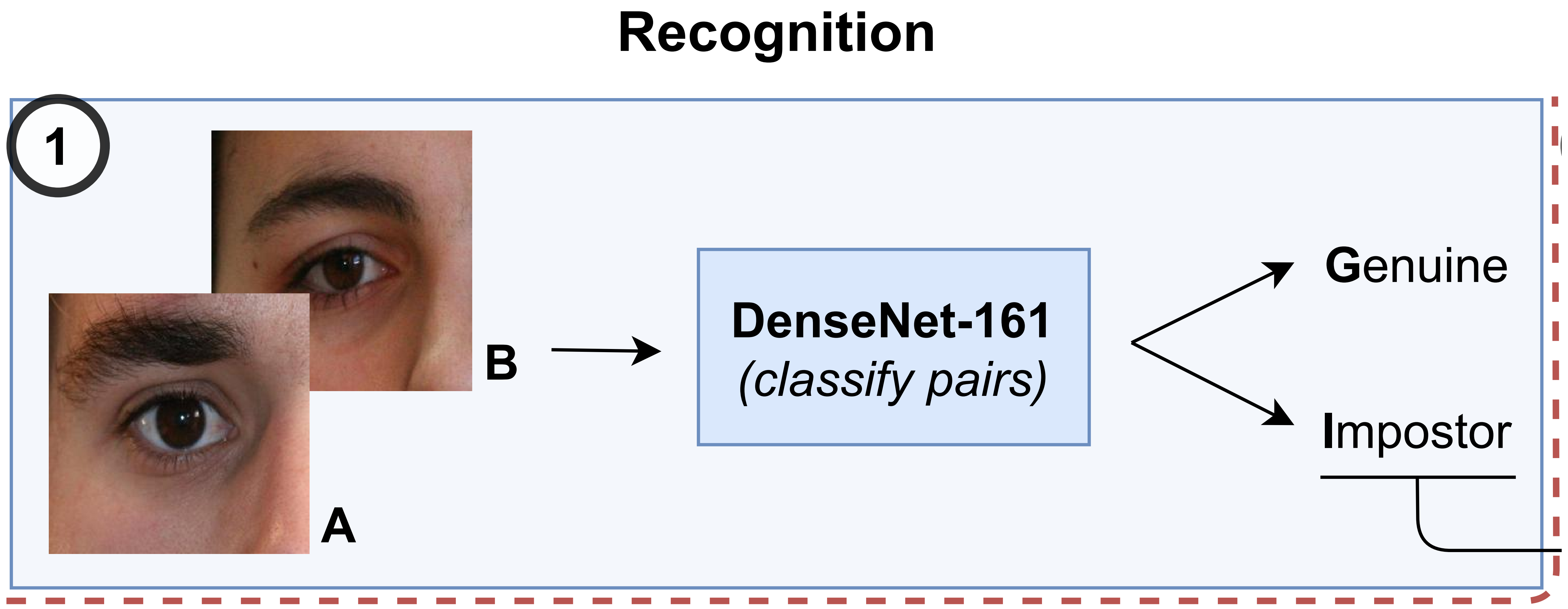



Overview of the proposed method.

# Proposed Method

## Recognition

- ✓ **Goal:** discriminate between "**Genuine**" and "**Impostor**" pairs
- ✓ **CNN** (DenseNet family)
- ✓ **Identity verification** problem




Recognition component of our framework.

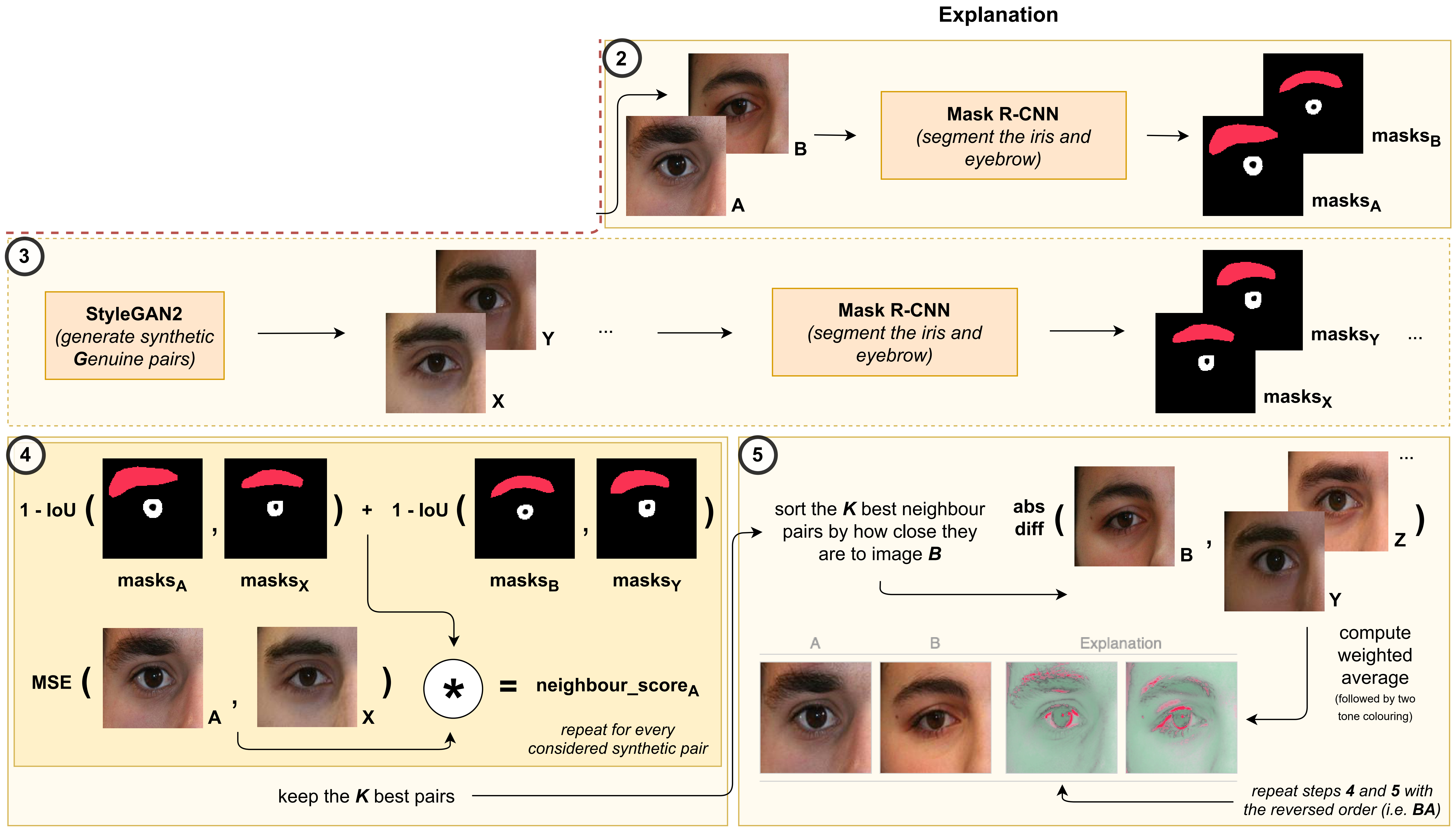
# Proposed Method

## Explanation

- ✓ **Goal:** produce visually pleasing explanations for the "Impostor" decision
- ✓ **Mask R-CNN** (for component segmentation)
- ✓ **StyleGAN2** (for high quality image synthesis)

"Which synthetic pairs are **closest** to our query?"

$$s_X = \omega_{\text{masks}} * ||\text{query\_pair}_A - \text{neighbour}_X||_2, \quad (1)$$




Explanation component of our framework.

# Qualitative Results

Regions that **contribute** to the **"Impostor"** class

Regions that **do not contribute** to the **"Impostor"** class


Readable and explainable results attained by our method.

# Recognition Results

- ✓ **Bootstrapping-like strategy** (90% of the UBIRIS.v2 dataset → 80% training + 20% test)
- ✓ **10 repetitions**
- ✓ Both world settings
- ✓ **Competitive** performance w.r.t. the state-of-the-art

| Method | EER | AUC |
|---|---|---|
| Ours (open-world) | $0.108 \pm 3e{-}2$ | $0.813 \pm 5e{-}2$ |
| Ours (closed-world) | $\mathbf{0.087 \pm 2e{-}2}$ | $\mathbf{0.910 \pm 2e{-}2}$ |
| Zhao and Kumar [23] | $0.109 \pm 2e{-}3$ | – |

Comparison between our framework and a state-of-the-art method on the UBIRIS.v2 dataset.

**[23]** Z. Zhao and A. Kumar. Accurate periocular recognition under less constrained environment using semantics-assisted convolutional neural network. IEEE Transactions on Information Forensics and Security, 12(5):1017–1030, 2017.

# Conclusions and Further Work

✓ **An integrated framework capable of delivering explainable justifications**

✓ **Modularity** allows for other recognition capabilities **without compromising the explanations**

✓ **Applicability to other domains** (e.g., facial recognition and subsequent explanation)

? Better **structuring** of the synthetic dataset (i.e., based on attributes), allowing for improved / faster search

# Questions?

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