



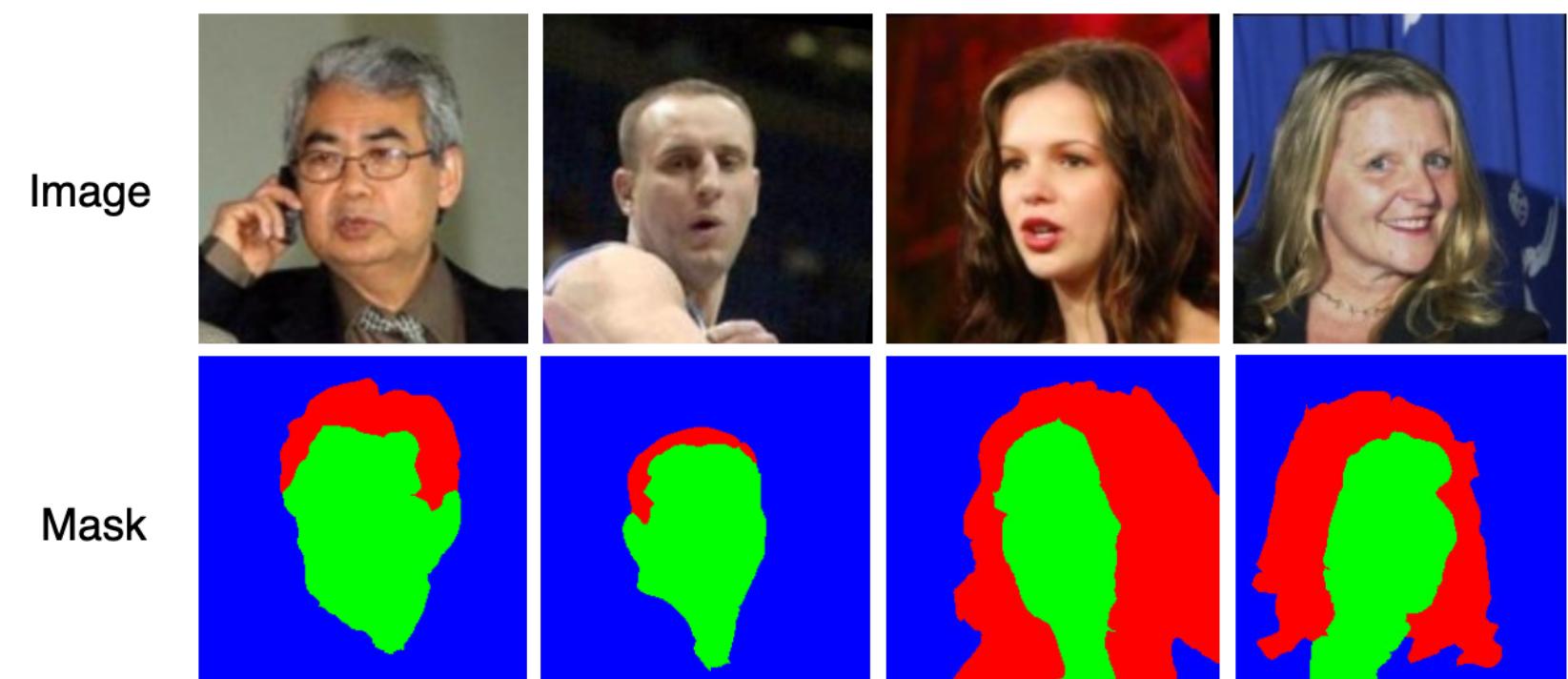
Deep Hair Segmentation, Matting and Application

Yulian Zhou¹, Yawen Sun², and Ziqi Wang³

¹Department of Computer Science, ²Department of Electrical Engineering, ³Department of Materials Science and Engineering

Dataset Overview

LFW parts dataset: It contains 2,927 250×250 images, and the corresponding masks are labeled as hair (red), face (green) and background (blue).



Project Description

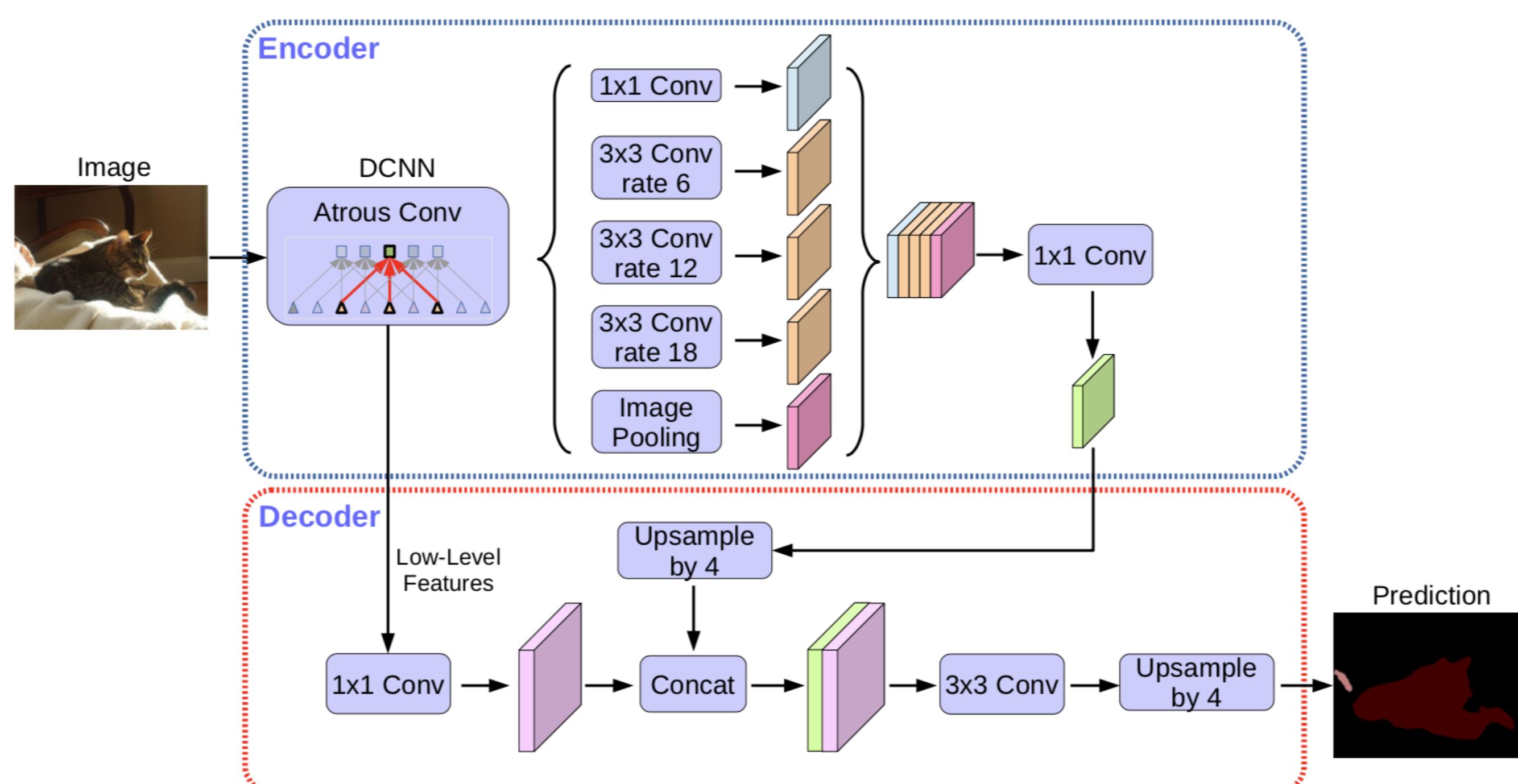
We aim to build an accurate and robust DeepLabv3+ based network for hair segmentation and matting.

Evaluation metrics:

- **Acc:** Per-pixel classification accuracy
- **Acc_class:** Averaged per-class Acc
- **mIoU:** Mean Intersection over Union
- **fwIoU:** Weighted-average of per-class mIoU

DeepLabv3+ Model Architecture

It adopts ‘astous convolution’, atrous spatial pyramid pooling, and encoder-decoder structure.



Baseline Model

Table: DeepLabv3+ with different backbones

Backbone	MobileNet	ResNet101	DRN	Xception
Acc	95.73%	96.98%	95.93%	93.47%
Acc_class	88.34%	89.92%	87.67%	82.30%
fwIoU	92.28%	94.30%	92.54%	88.74%
mIoU	80.49%	85.07%	80.87%	72.43%
Loss	0.05751	0.04279	0.0547	0.3906
Time/Epoch	27.05	44.30	57.15	35.55

Table: Effect of backbone fine-tune

learning_rate			Best model epoch80
backbone	other	mIoU	loss
0	0.001	85.95%	0.04318
0	0.0001	85.23%	0.04439
0.0001	0.001	89.03%	0.03561
0.00001	0.0001	87.95%	0.03782
0.00001	0.001	87.99%	0.03676

Model Improvement

- Various data argumentation and *mixup*

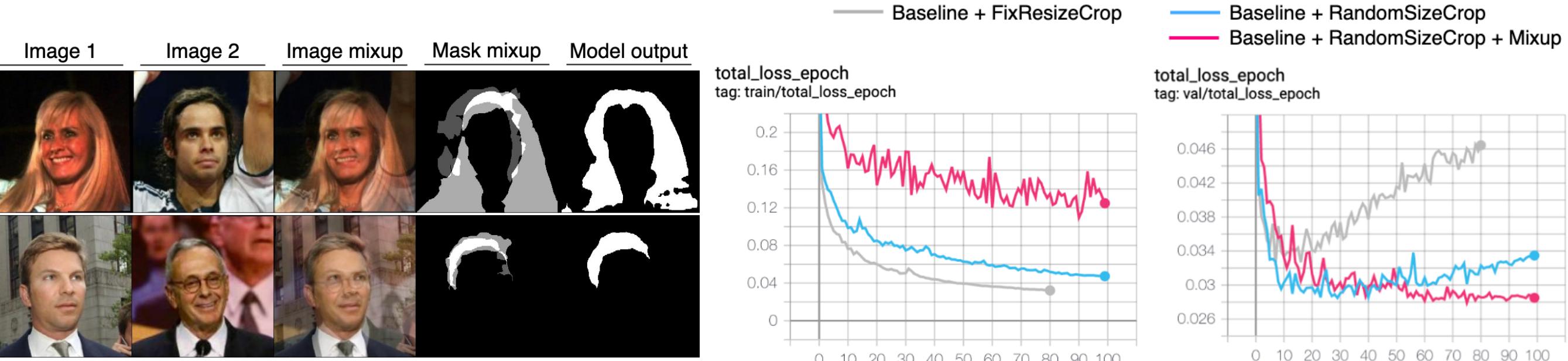


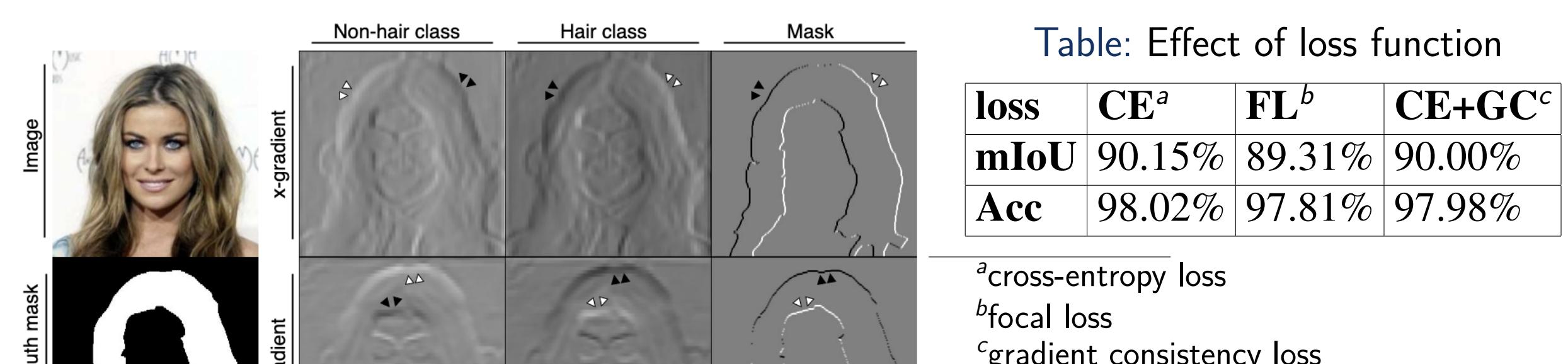
Table: Effect of data argumentation and *mixup*

	Baseline	Baseline+RSC ^a	Baseline+RSC+GB ^b	Baseline+RSC+GB+Mixup $\alpha = 0.2$	Baseline+RSC+GB+Mixup $\alpha = 0.4$
mIoU	89.03%	90.08%	90.15%	90.21%	90.32%
Loss	0.03561	0.0324	0.03064	0.02792	0.02855

^arandom size crop

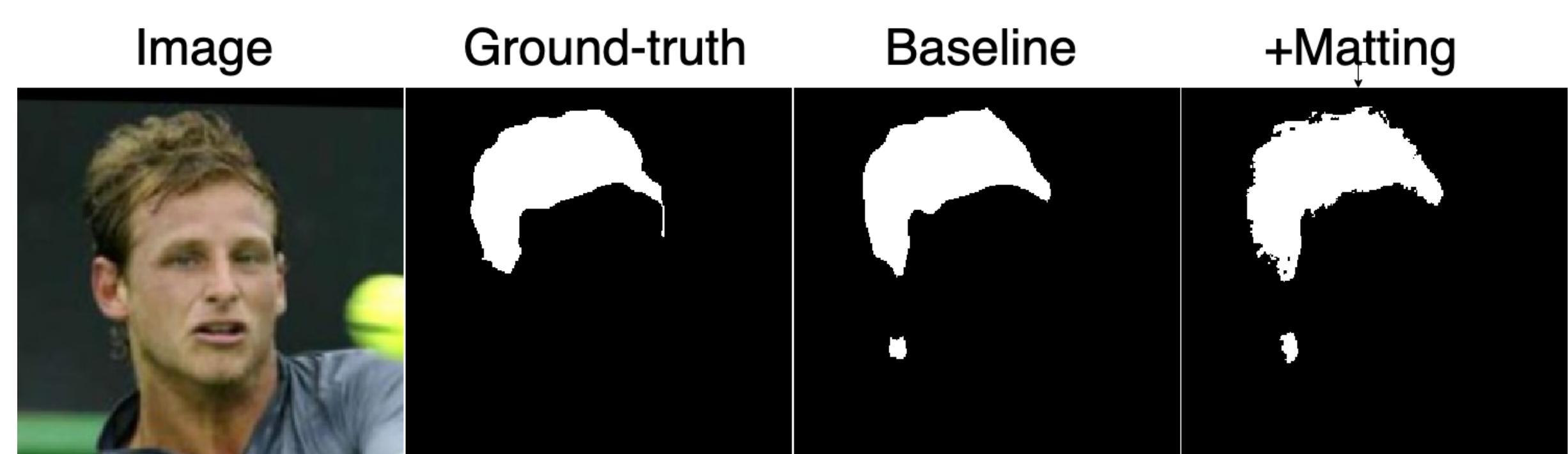
^bGaussian blur

- Gradient consistency loss



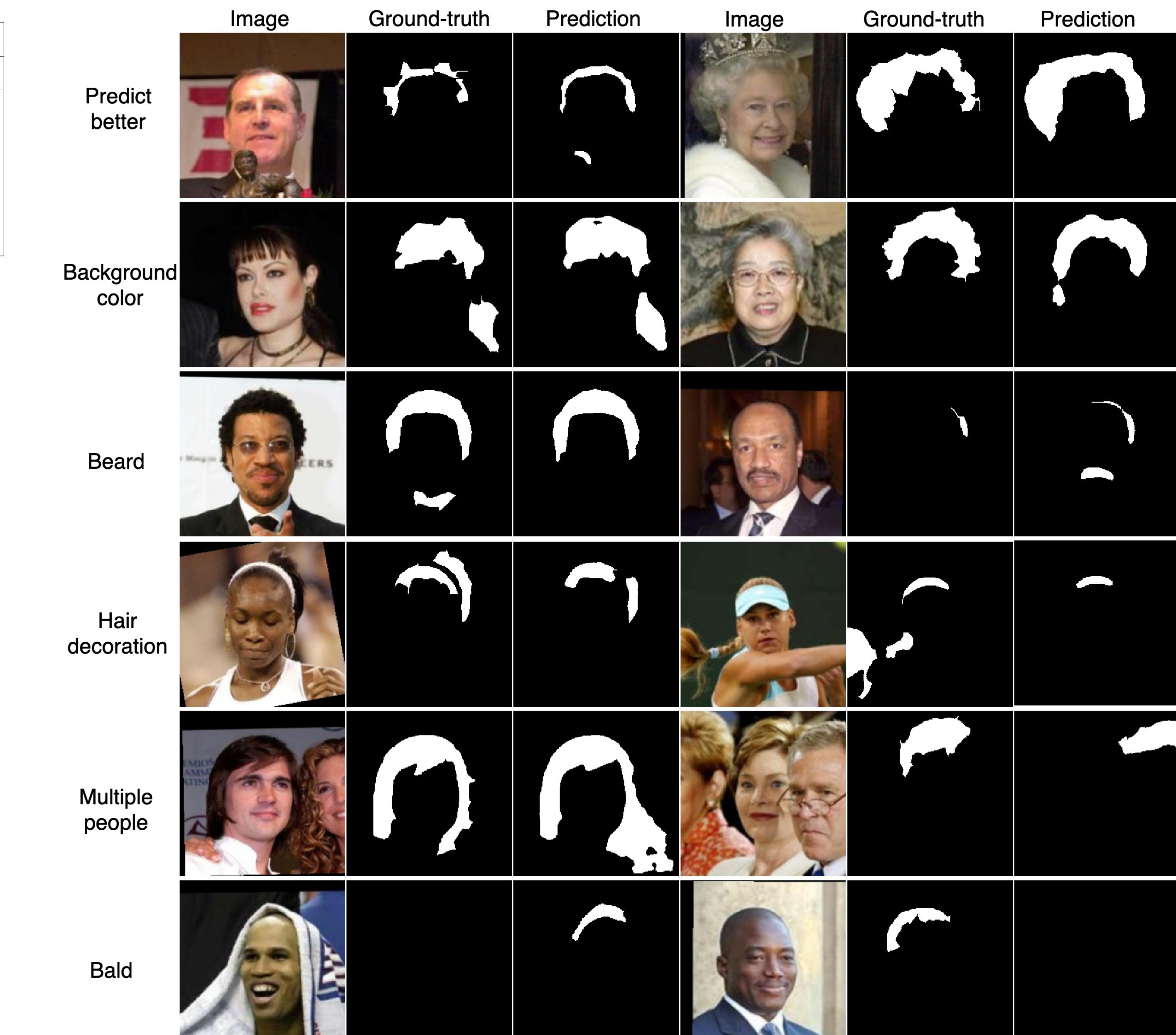
Hair Matting

Segmentation output with / without hair matte:



Error Analysis

Visualization of segmentation errors on the LFW dataset:



Conclusions

- The DeepLabv3+ network with ResNet backbone is well-suited for hair segmentation task.
- Random size crop and mixup improve model performance, and hair matting refines the mask detail.
- Our MobileNet based network achieved **91.6%** mIoU, and we'd like to develop mobile application to perform real-time hair segmentation and coloring in the future.

Acknowledgement

The authors would like to thank all CS231N course staff for instructions and guidance on this project, and we especially thank Apoorva Dornadula, Winnie Lin, Haoye Cai, and Kaidi Cao for giving insightful inputs.