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ADLxMLDS
Final Project

# Paper Reproduction: Image Editing with FaderNet[1]

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## Problem Definition

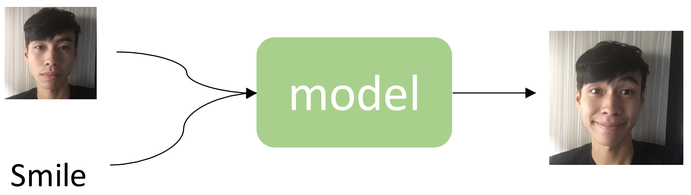
**Image editing via manipulating attributes:**

Input

Source image & assigned attribute(s)

Output

A retouched image with assigned characteristic




- Supervised Learning

  Attribute labels are provided during training

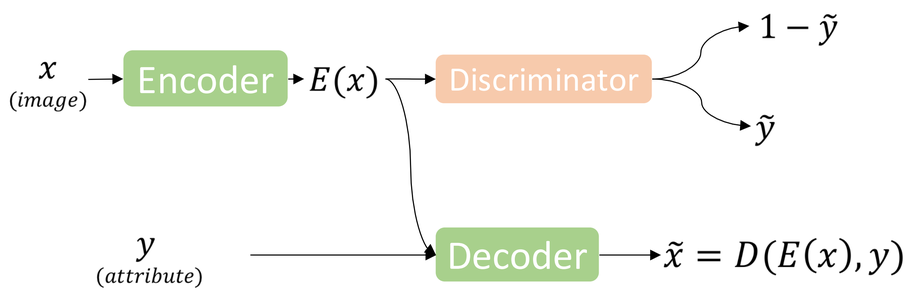
## Data

The well known human face dataset CelebA[2], providing 200K images of celebrity, each with 40 binary attributes.

| Blond Hair | Smiling | Young | Eyeglasses | ... |
|---|---|---|---|---|
| True | True | False | False | ... |

Images have been preprocessed into 256x256.

## Methodology




↑ Architecture of FaderNet

The key point of FaderNet is adversarial learning at feature level in order to separate the targeted attributes from encoded feature.

The discriminator is trained to minimize the **classification error**

$$L_D = CrossEntropy(\tilde{y}, y)$$

The **adversarial objective** is defined as follows.

$$L_A = CrossEntropy(\tilde{y}, 1-y)$$

The **reconstruction objective** is defined as follows.

$$L_R = MSE(\tilde{x}, x)$$

The Auto-Encoder is trained to minimize the reconstruction loss on input image together with the adversarial objective

$$L_{AE} = L_R + \lambda L_A$$

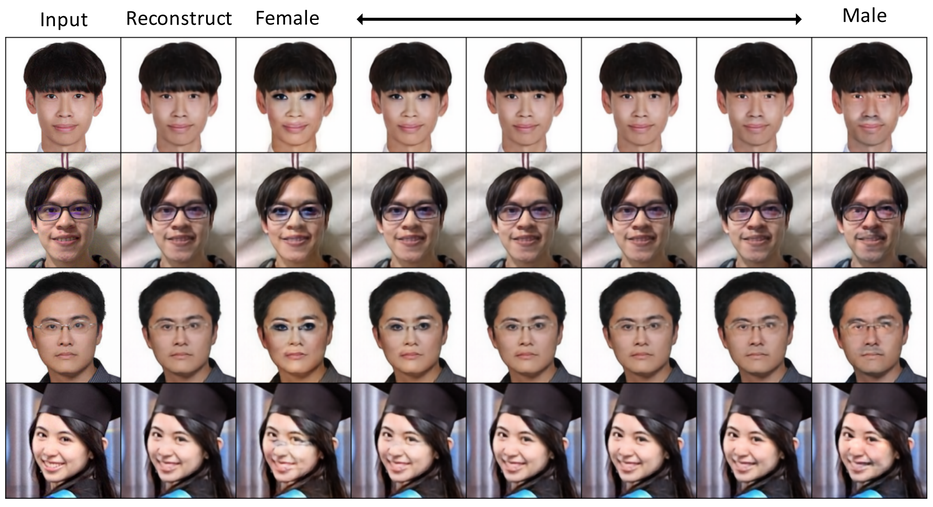
In conclusion, the encoder is trained to compress the image without involving attribute-related information. On the other hand, the decoder is requested to construct images with the attribute-free latent representation and the assigned attribute.

## Experiments

The paper provides comparison with IcGAN and outperforms it on human evaluation.
We'll focus on other aspects of this work in our experiments.

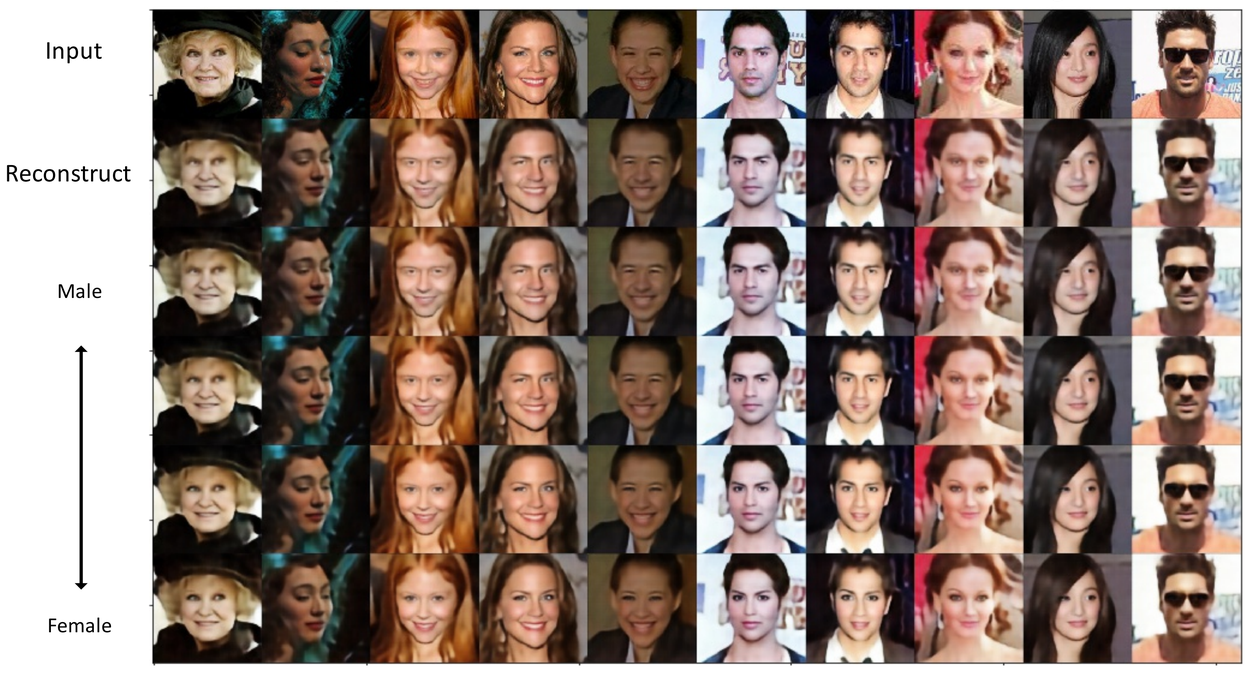
### Universality

Results of testing the model with images different from CelebA




### Reproducibility

While FaderNet seems to be an elegant way of image editing, the paper specified that the final model selection is decided through human evaluation.

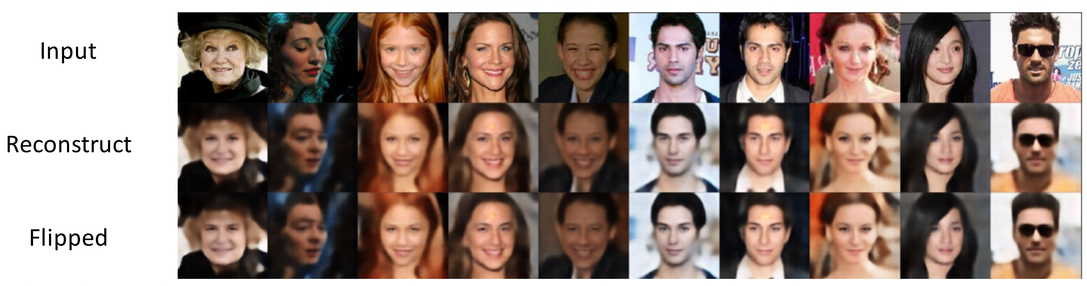



### Ablation Study

We further conducted experiments to verify the effects of

(a) inserting attributes to decoder, and


(b) adversarial training on encoder.




Results show that inserting attribute to every layer of decoder is important.
Also, removing adversarial training leads the decoder to completely ignore the inserted attribute, as is claimed in the paper.

## Conclusion

Pros

- Good result with simple architecture/objective
- Creative way to accomplish feature disentanglement
- Training with binary label but able to perform continuous editing (with hacky trick)

Cons

- Unlike normal AE, FaderNet is extremely hard
- Only binary attributes are tested and reported in the paper, while we achieved poor performance on multiclass attributes such as hair/eye color

## References

[1] G. Lample, N. Zeghidour, N. Usunier, A. Bordes, L. Denoyer, and M. Ranzato. Fader networks: Manipulating images by sliding attributes.
[2] Ziwei Liu, Ping Luo, Xiaogang Wang, and Xiaoou Tang. Deep learning face attributes in the wild. In Proceedings of International Conference on Computer Vision (ICCV), 2015.