

Style Transfer with Facial Preservation

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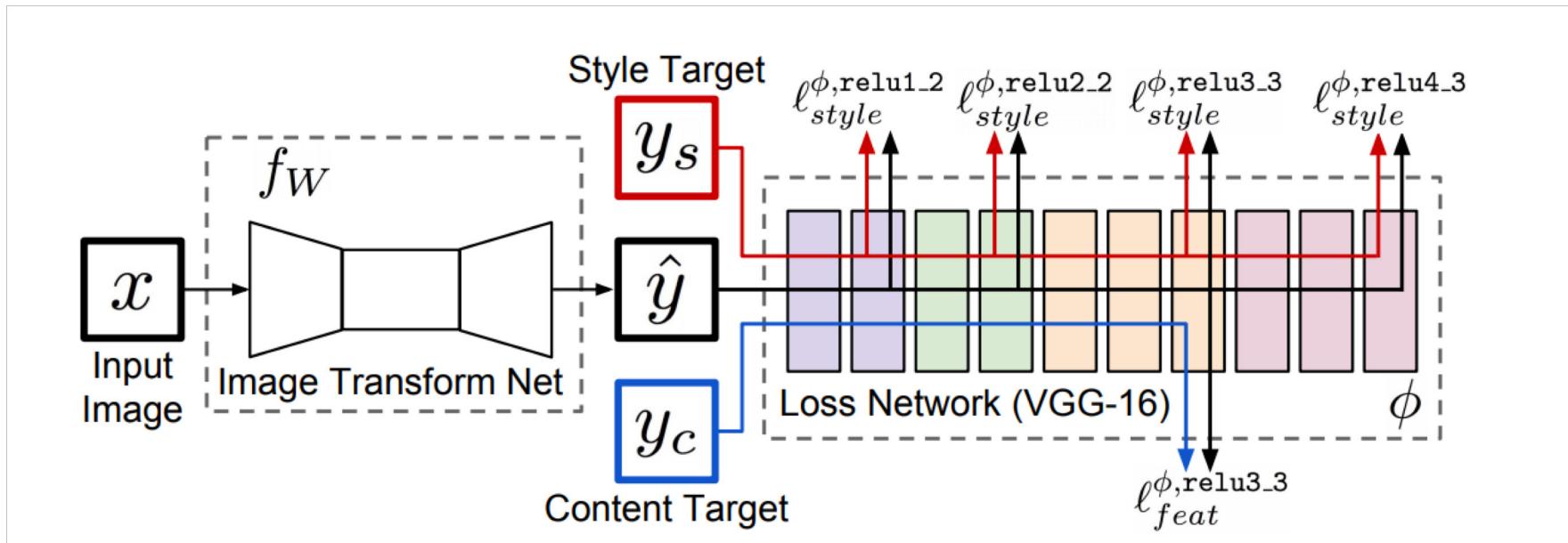
Style Transfer with Facial Preservation

- Style Transfer:
 - Transfer the style from one image onto the content of another image
- Our Goal:
 - Extend the standard style transfer methodology to accommodate target content preservation (faces to start with)



Fast Style Transfer (Johnson et al.)

- Use perceptual loss to train an image transformation network to learn style transfer
- Learn an image transformation network for a single style image



Perceptual Loss

- Use a pretrained image classification network to quantify the perceptual difference of two images
- Activation layers of a convolutional neural network contain a high level understanding of the
 - style (earlier layers)

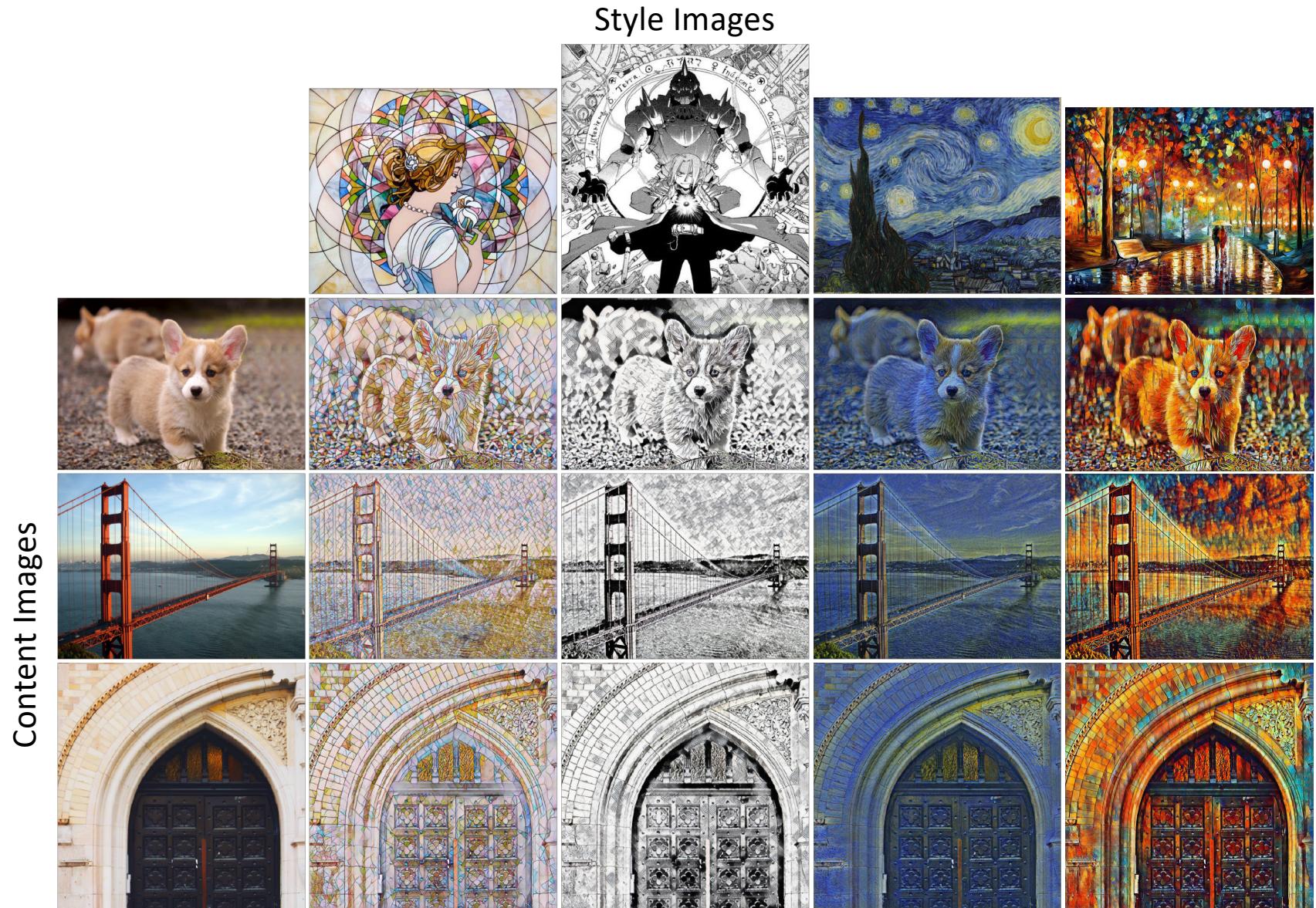
$$G_j^\phi(x)_{c,c'} = \frac{1}{C_j H_j W_j} \sum_{h=1}^{H_j} \sum_{w=1}^{W_j} \phi_j(x)_{h,w,c} \phi_j(x)_{h,w,c'}$$

$$\ell_{\text{style}}^{\phi,j}(y, y_s) = \|G_j^\phi(y) - G_j^\phi(y_s)\|_F^2$$

- content (later layers)

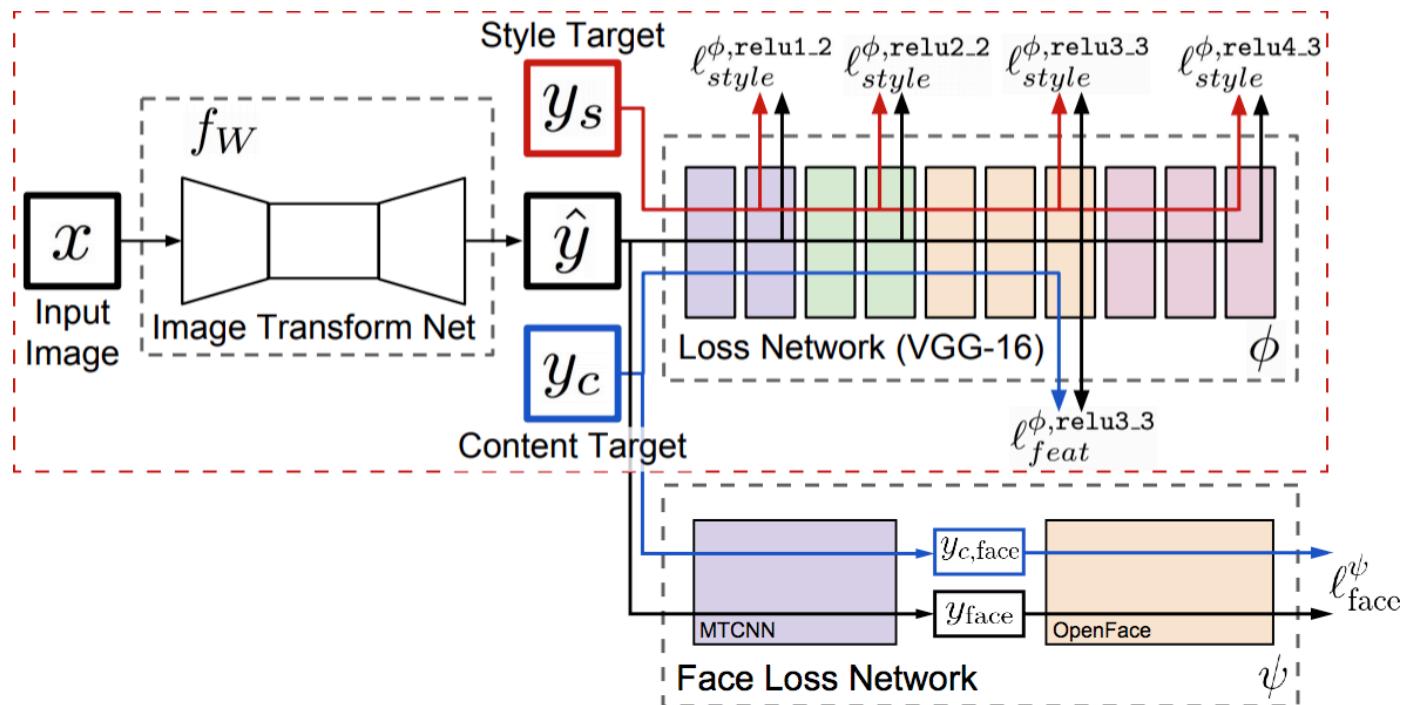
$$\ell_{\text{content}}^{\phi,j}(y, y_c) = \frac{1}{C_j H_j W_j} \|\phi_j(y) - \phi_j(y_c)\|_2^2$$

Results of Style Transfer

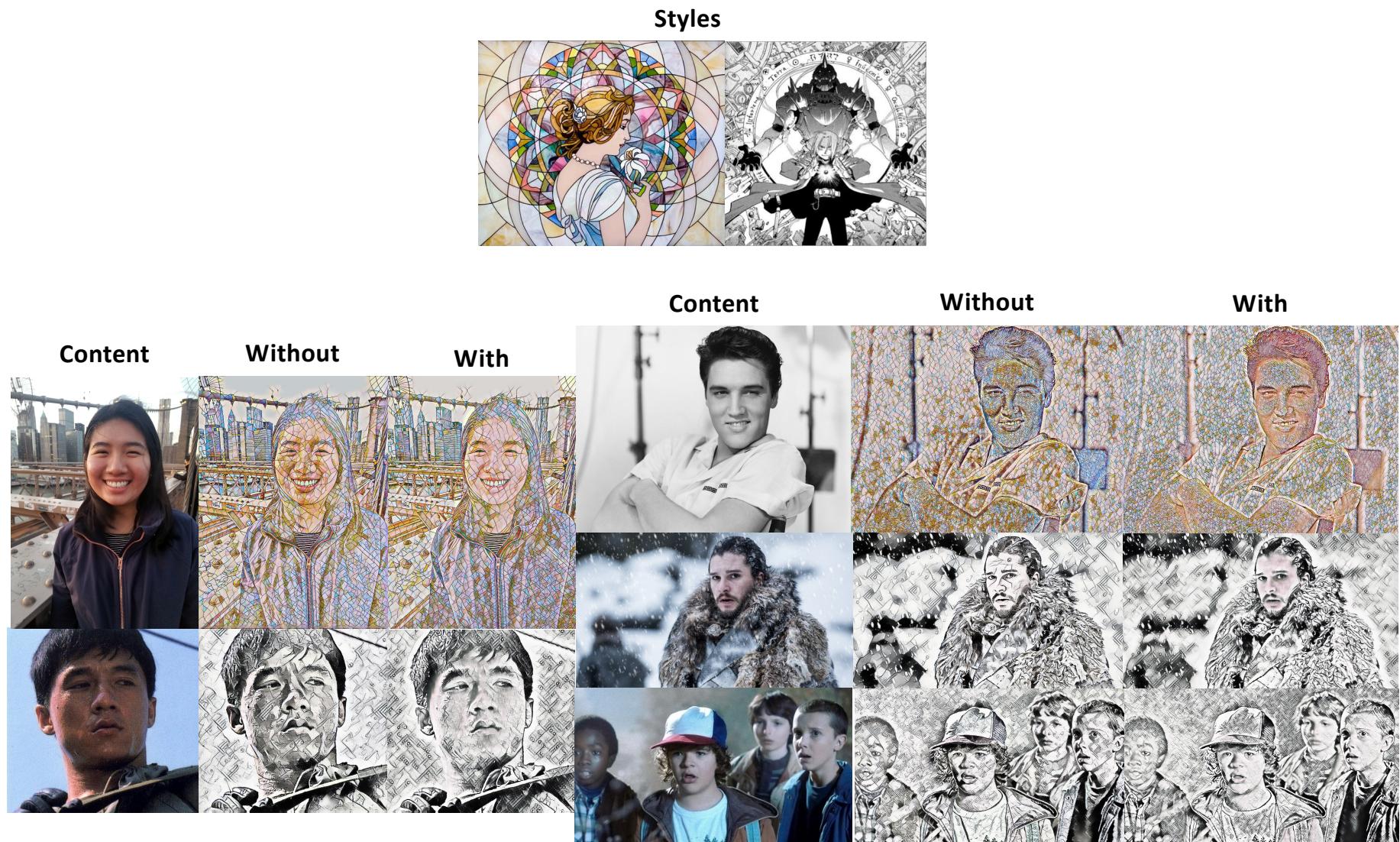


Extension: Face Loss

- Use “Joint Face Detection and Alignment using Multi-task Cascaded Convolutional Networks” to find faces (Zhang et al. 2016)
- Use *OpenFace* to compute a face descriptor (Amos et al. 2016)
- The face loss is then the squared distance between descriptors of the face in the original image and the stylized image

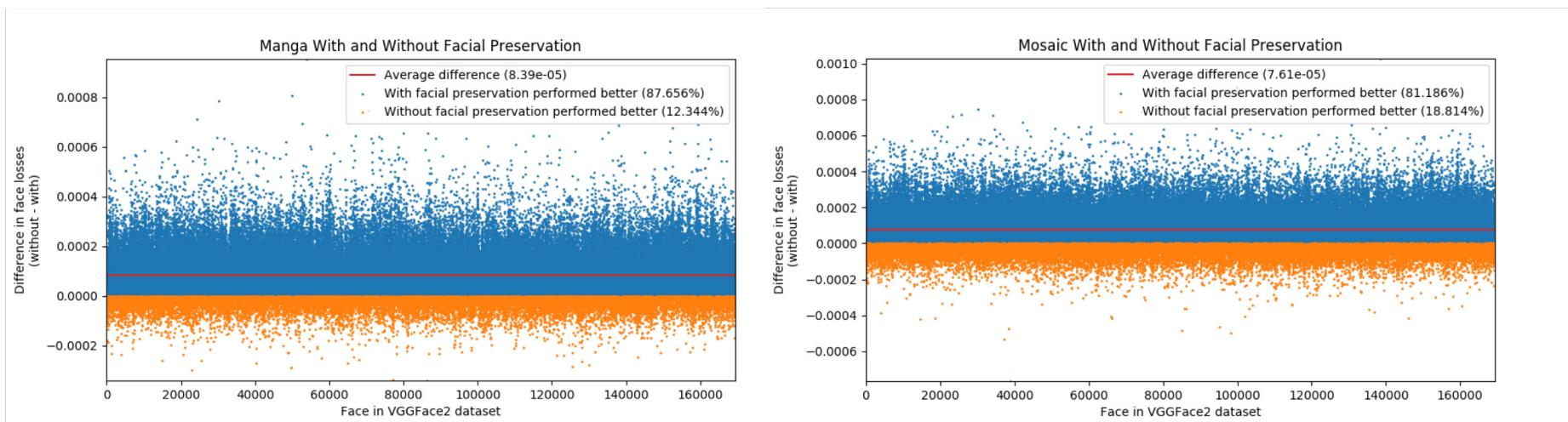


Results of Facial Preservation



Quantitative Results

- We can measure the results of facial preservation by computing the face loss over a face data set (VGGFace2)
- Plot the difference between face loss with and without facial preservation



Limitation and Future Work

- Others have extended Fast Neural Style Transfer to allow for multiple and arbitrary styles per trained model
- Could improve the face preservation by using “attention” to focus the loss network on faces rather than general image classification
 - Face Attention Network: An Effective Face Detector for the Occluded Faces (Wang et al. 2017)
- Training time is greatly increased with the addition of the face loss network
 - MTCNN and OpenFace slow the optimization loop
- Train on a face dataset instead of a general image dataset