Tools Used

scikit-video
video processing in python

NumPy

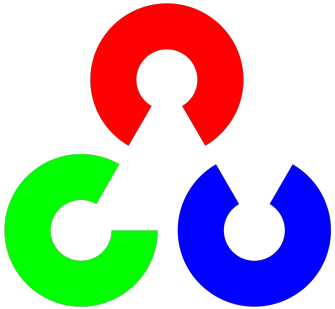
PYTORCH

Streamlit

pillow

python

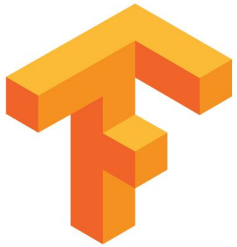
Keras



OpenCV

NVIDIA
CUDA

lib



TensorFlow

cuDNN

matplotlib

Image Creation with Generative Adversarial Networks

September 15, 2020

Sub Projects

Neural Style Transfer

- Functional style transfer app

StyleGAN Encoder

- Proof of concept face blending app

Face Swap

- Functional face swap app

Neural Style Transfer

https://medium.com/@build_it_for_fun/neural-style-transfer-with-swift-for-tensorflow-b8544105b854

Style

+

Content

=

Result

Total Loss Function

$$\mathcal{L}_{total}(\vec{p}, \vec{a}, \vec{x}) = \alpha \mathcal{L}_{content}(\vec{p}, \vec{x}) + \beta \mathcal{L}_{style}(\vec{a}, \vec{x})$$

Content of final image → similar to content image

Style of final image → similar to style image

Goal: minimize loss

https://towardsdatascience.com/a-brief-introduction-to-neural-style-transfer-d05d0403901d

Training Data:

Flickr Faces HQ Dataset - 168,000 aligned faces

Stop at 10,000 iterations

Some pictures used as “styles” to train on:

https://github.com/jcjohnson/fast-neural-style

Detail

400 iterations

10,000 iterations

+

2000 iterations

=

=

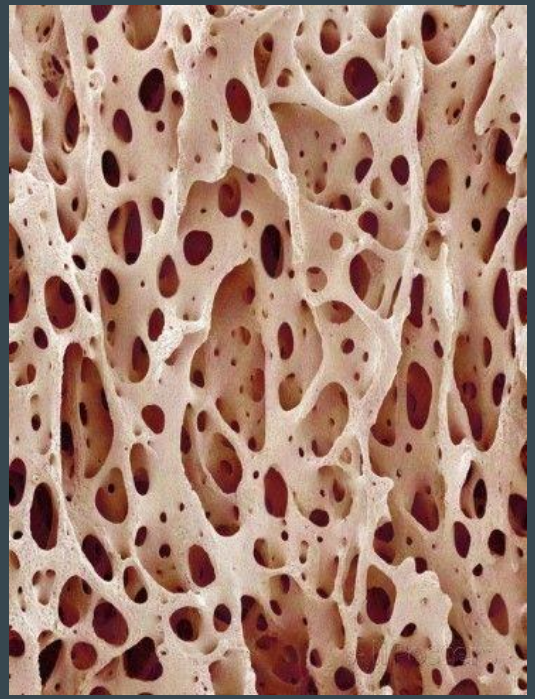
+

8,000 iterations

=

$\lambda\_style = 1e10$

+

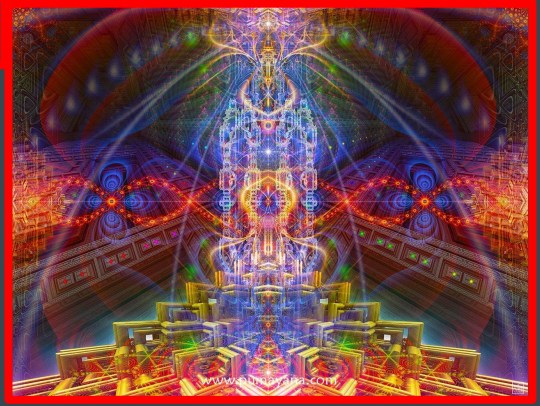


12,000 iterations

=

6000 iterations

31,000 iterations



Neural Style Transfer | StyleGAN Encoder | Face Swap

Choose a pic

IMG_5673.jpg

browse files

Select a pretrained model

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/mo...

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/mp,840x830,matte,f8f8f8,t-pad,1000x1000,f8f8f8_2000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/Pablo-Picasso-Lee-Millers-Portrait-as-Arlesienne-1937_2000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/3257184-ODITVTBS-7_2000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/a_31000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/vinny3_6000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/https___i_120000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/vinny2_6000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/fracc_2000.pth

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/models/fractal4_10000.pth

Choose a pic

IMG_5673.jpg

browse files

Select a pretrained model

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Choose a pic

IMG_5673.jpg

browse files

Select a pretrained model

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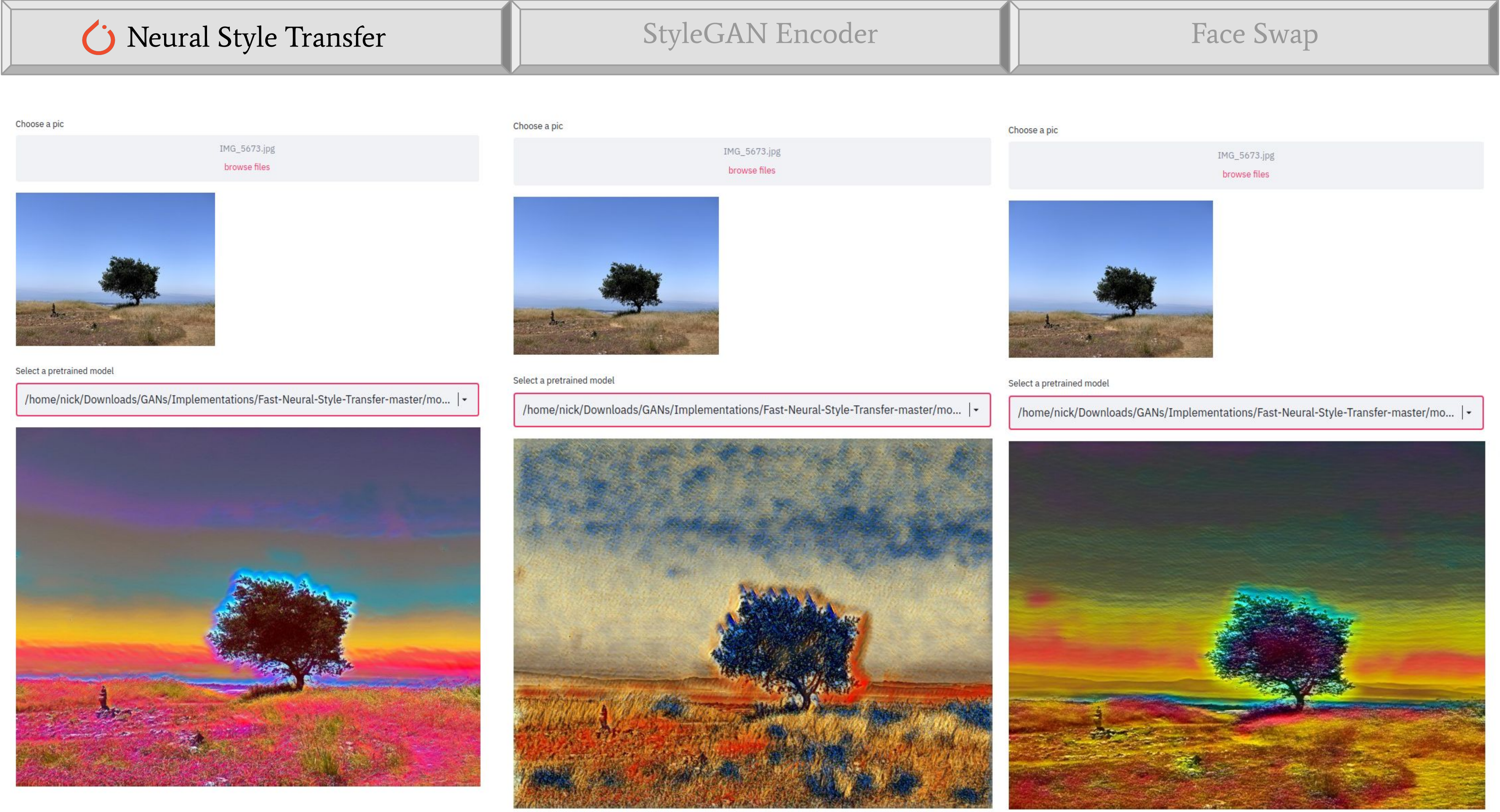
Neural Style Transfer
StyleGAN Encoder
Face Swap
Choose a pic
IMG_5673.jpg
browse files
Select a pretrained model
/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/mo...
Choose a pic
IMG_5673.jpg
browse files
Select a pretrained model
/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/mo...
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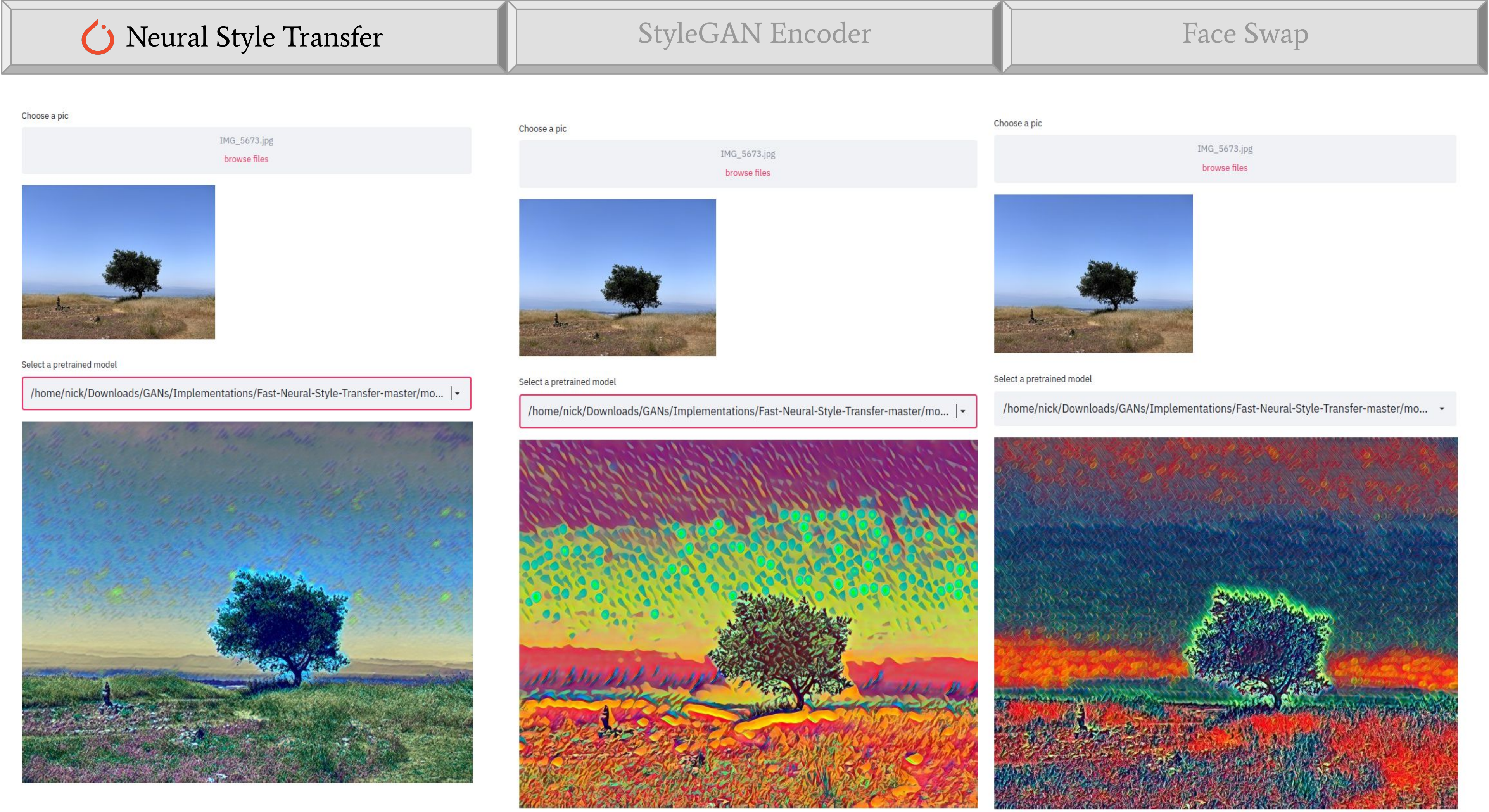

Neural Style Transfer
StyleGAN Encoder
Face Swap
Choose a pic
IMG_5673.jpg
browse files
Select a pretrained model
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Choose a pic
IMG_5673.jpg
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/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/mo...
Choose a pic
IMG_5673.jpg
browse files
Select a pretrained model
/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/mo...

Neural Style Transfer

StyleGAN Encoder

Face Swap

Choose a pic

IMG_4147.jpg

browse files

Select a pretrained model

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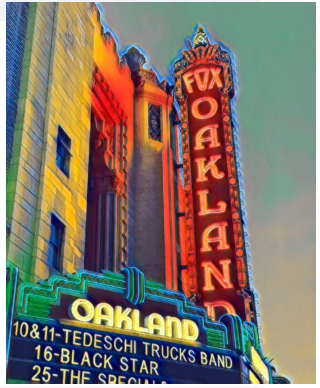
IMG_5591.jpg

browse files



Select a pretrained model

/home/nick/Downloads/GANs/Implementations/Fast-Neural-Style-Transfer-master/mo...

StyleGAN Encoder

Training Data:

Flickr Faces HQ Dataset - 168,000 aligned faces

LSUN - Cars, Churches, Cats, Horses

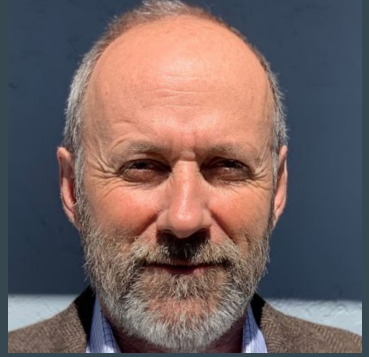
- Perceptual loss function

- L1 Penalty on latent vectors

https://github.com/pbaylies/stylegan-encoder



+



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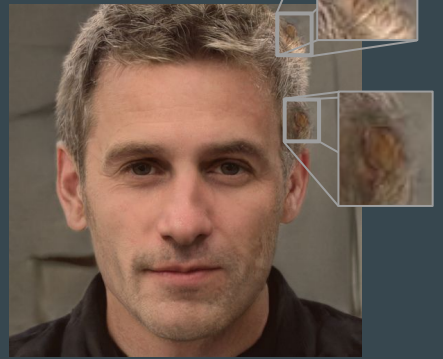
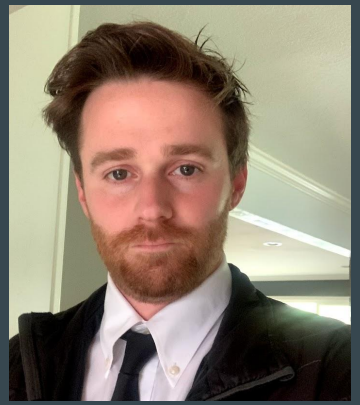


Neural Style Transfer

StyleGANEncoder

Face Swap

Combining Latent Representations



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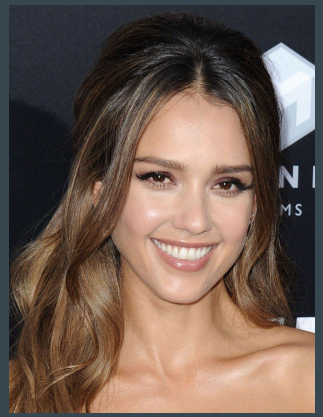

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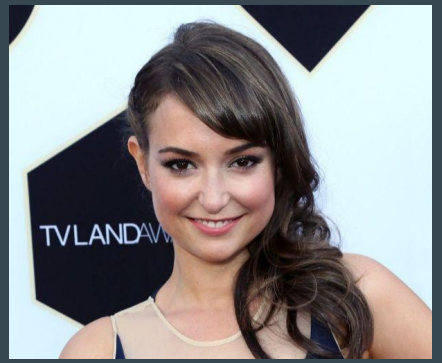

picture 1

0.01

0.01 0.99

picture 2

0.99

0.01 0.99

picture 3

0.01

0.01 0.99

picture 1

0.33

0.01 0.99

picture 2

0.99

0.01 0.99

picture 3

0.01

0.01 0.99

picture 1

0.66

0.01 0.99

picture 2

0.99

0.01 0.99

picture 3

0.01

0.01 0.99

picture 1

0.99

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picture 2

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picture 3

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picture 1

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picture 3

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picture 1

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picture 2

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picture 1

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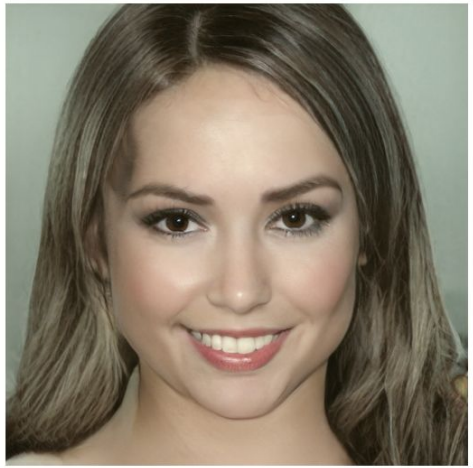


picture 1

0.99

0.01 0.99

picture 2

0.01

0.01 0.99

picture 3

0.99

0.01 0.99

picture 1

0.14

0.01 0.99

picture 2

0.73

0.01 0.99

picture 3

0.99

0.01 0.99

picture 1

0.01

0.01 0.99

picture 2

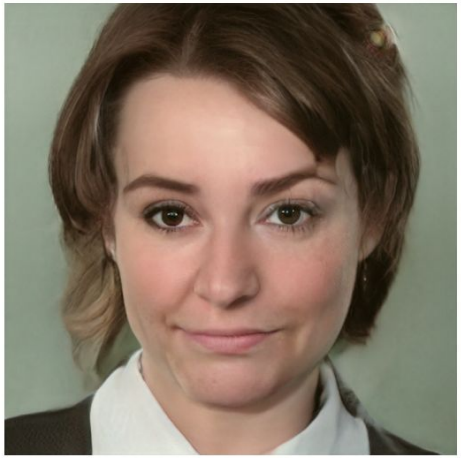
0.73

0.01 0.99

picture 3

0.99

0.01 0.99



picture 1

0.01

0.01 0.99

picture 2

0.99

0.01 0.99

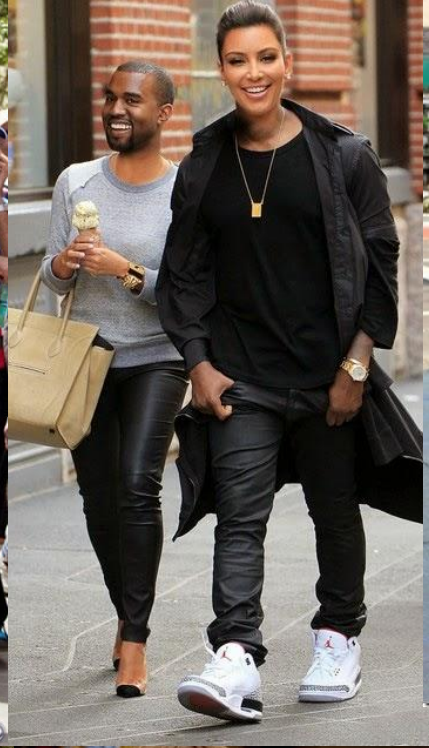
picture 3

0.99

0.01 0.99

Face Swap

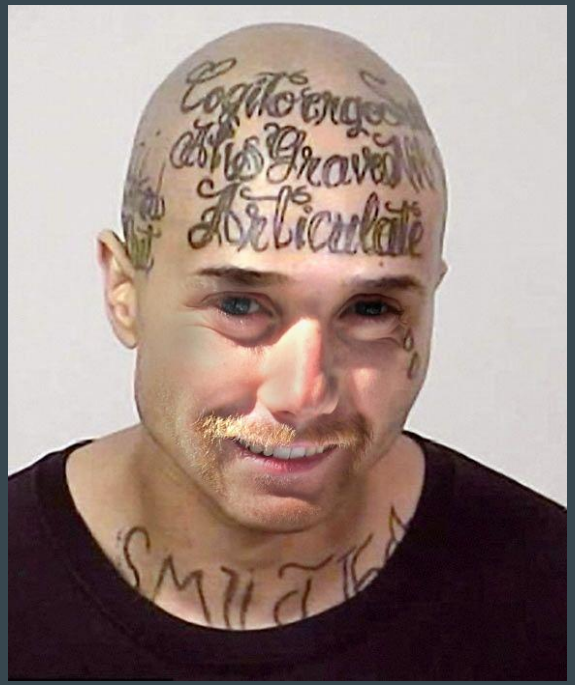


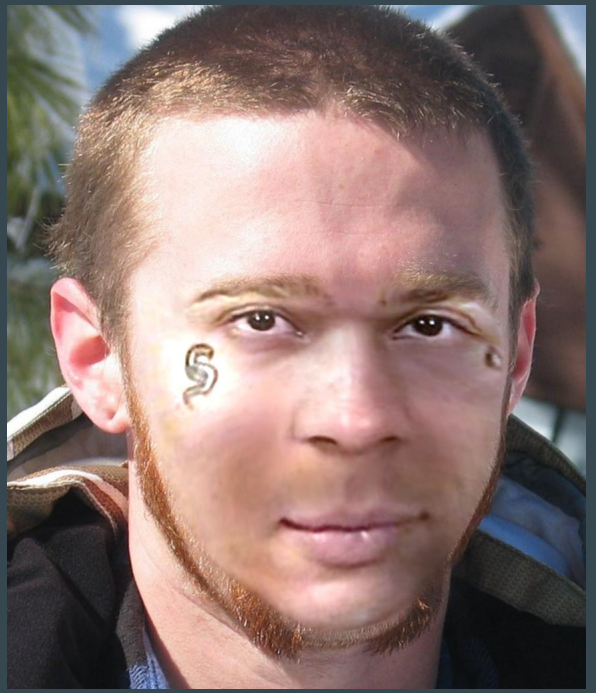







https://www.designstack.co/2013/07/face-swapping.html





Face Swap Steps

1. Detect and align faces from both images using facial landmarks
2. Warp the face from the source image to fit the aligned face in the destination image
3. Perform color correction and blur boundary edges

Choose a picture

daniel_craig.jpg

browse files

Choose another picture

michael.jpg

browse files

Swap Faces ⬇️

Swap Faces ⬆️

af01bb3a3c633c1ab7572e95c46e6710.jpg

browse files

Choose another picture

Bill_Clinton.jpg

browse files

Swap Faces ⬇️

Choose another picture

ccd84fb3ebef84d412b458435b281d7e.jpg

browse files

Swap Faces ⬇️

Swap Faces ⬆️

Future Work

Add Upload Functionality

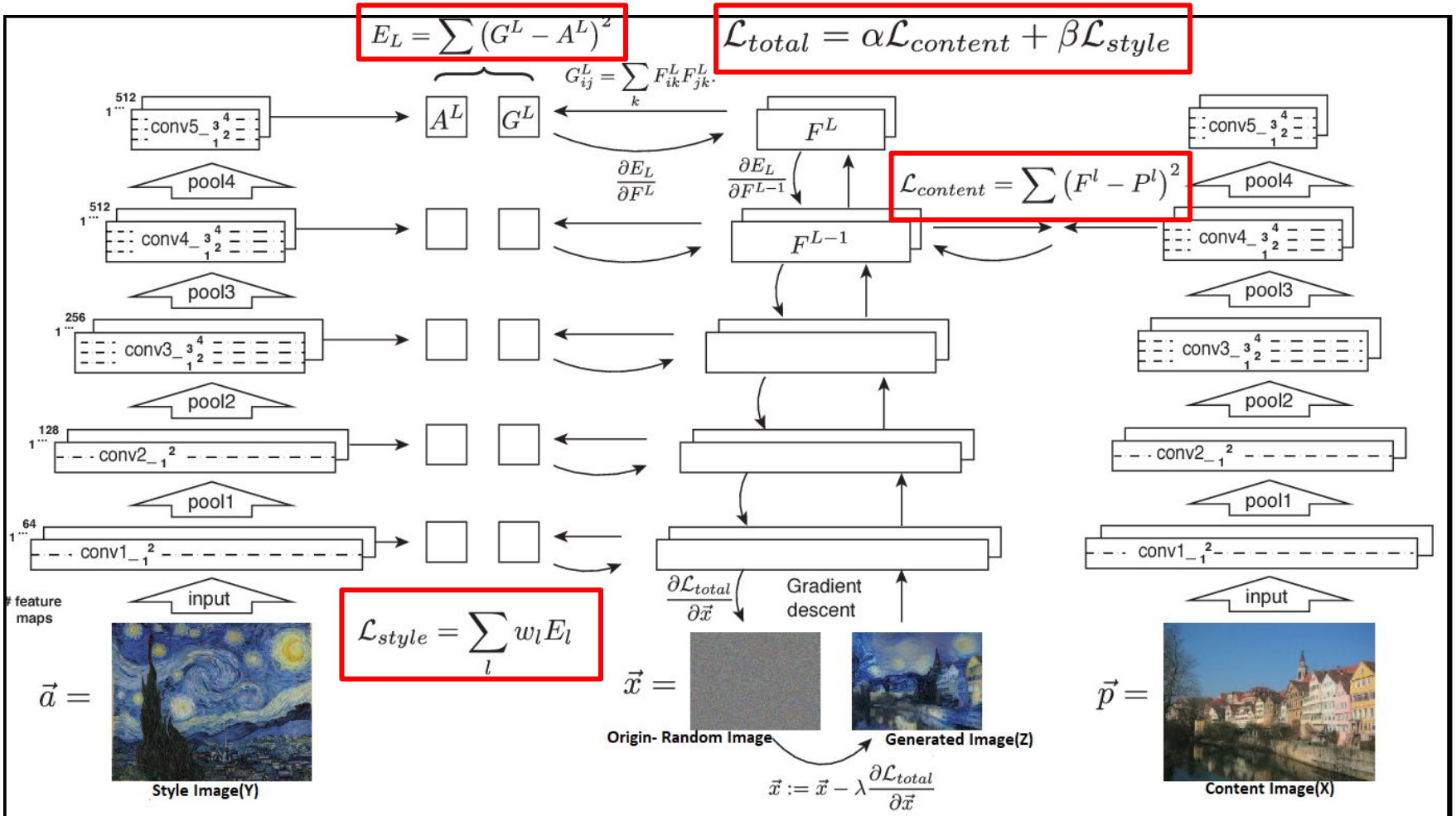
- Add functionality for uploading your own images to the StyleGAN Encoder App

Host Apps

- Create a personal website with all three apps

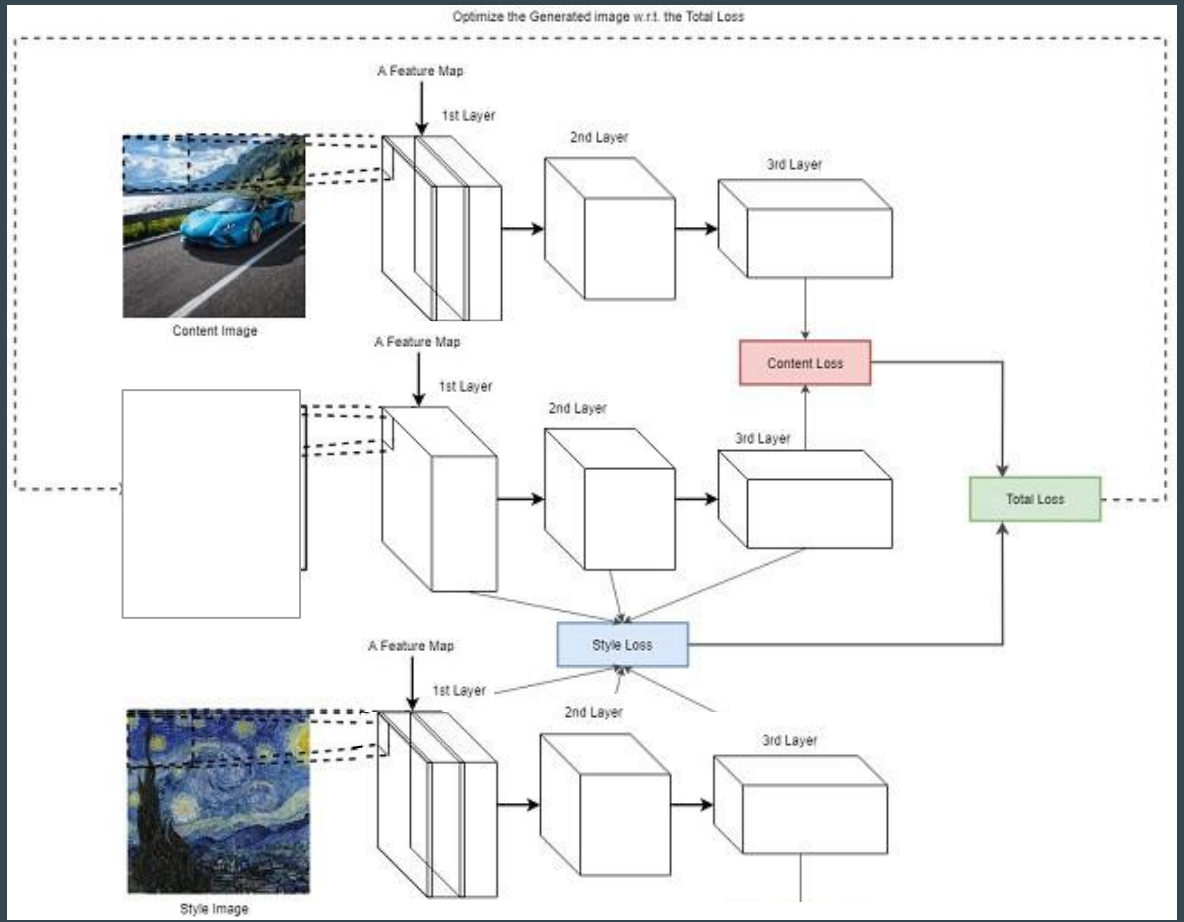
Thanks for Listening!

Appendix



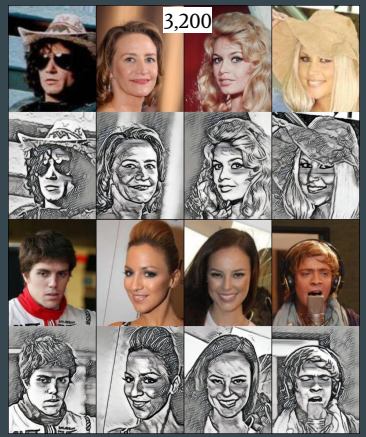
Detailed CNN Architechture - Neural Style Transfer

https://towardsdatascience.com/neural-style-transfer-on-real-time-video-with-full-implementable-code-ac2dbc0e9822



https://towardsdatascience.com/light-on-math-machine-learning-intuitive-guide-to-neural-style-transfer-ef88e46697ee#:~:text=a%20whopping%20%24432%2C500.-,High%20level%20architecture,to%20transfer%20a%20style%20to

Training



StyleGAN Encoder

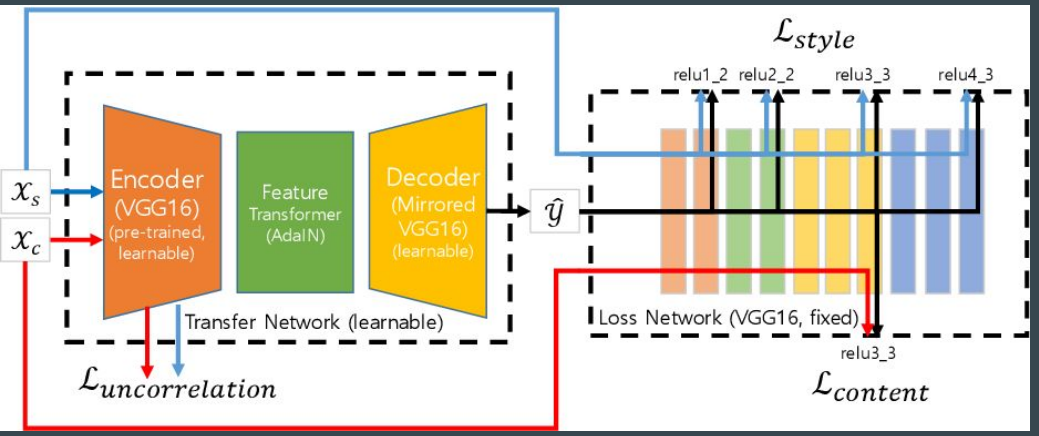


Image transformation tasks: a system receives some input image and transforms it into an output image.

A previously used approach: per-pixel loss function. Scenario: shifted by one pixel: per-pixel says its much different, even tho its not

New approach: perceptual loss function - instead of differences between pixels, based on differences between high-level image feature representations extracted from CNN. Images are generated by minimizing a loss function.

Uses perceptual loss function to compare high level differences like content and style discrepancies between two images.

The perceptual loss function works by summing all the squared errors between all the pixels and taking the mean Johnson et al. (2016).

https://towardsdatascience.com/perceptual-losses-for-real-time-style-transfer-and-super-resolution-637b5d93fa6d

Steps in Face Swap

Detect Faces

Uses OpenCV to locate faces.

1. Upsamples image
2. Loops over 68 facial landmarks and converts them to a 2-tuple of (x, y) coordinates

Uses ----- to detect faces. If more than one face is visible in the picture, it puts a red box around each face and you click on the face you want.

Face Swap

3d warp... ?

Generates a mask over the face coordinates, this is the area that will be swapped

Shrink mask

Poisson blending

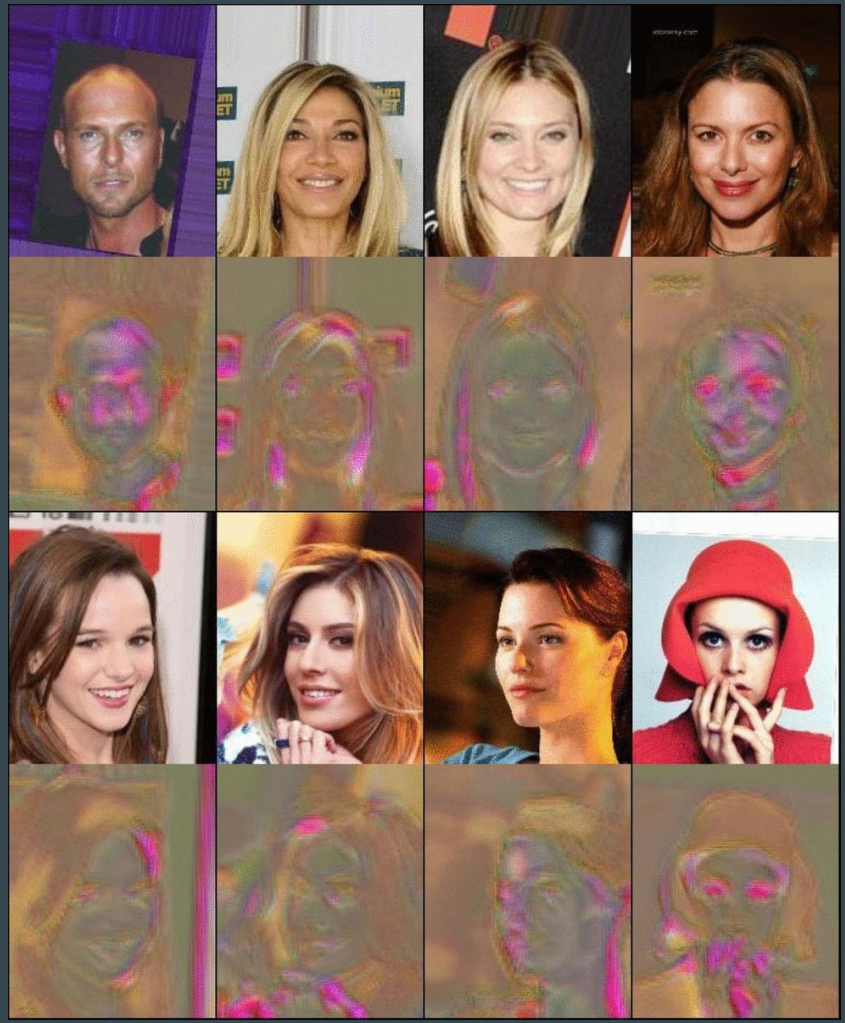
Calculates triangular affine matrices

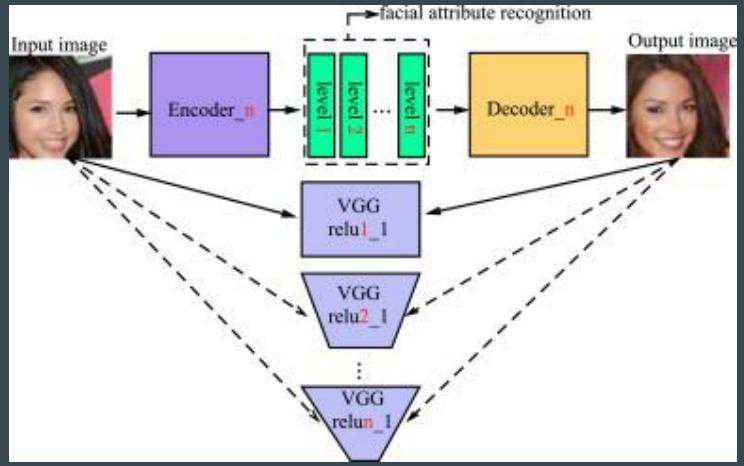
Uses bilinear interpolation to place the source face onto the destination head

Finishing Touches

Optionally performs color correction, makes the result look much more natural

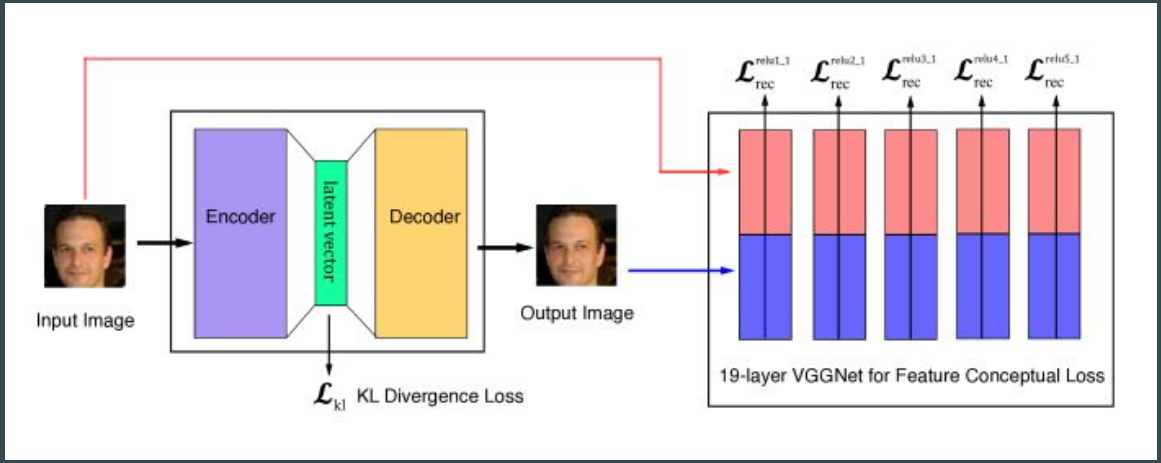
Uses Gaussian blur to smooth the edges between boundary of source face & destination head using a normal distribution for a clean looking transition





About StyleGAN Encoding

- Image transformation - receive an image, transform into output image
- Per-pixel loss functions are not ideal for image recreation
- We want to compare high level features regardless of their location in the image... Perceptual Loss!
- Uses direct optimization for latent representation
- Uses a facial identity loss function to preserve identity features (usually facial identity is lost in latent representations)

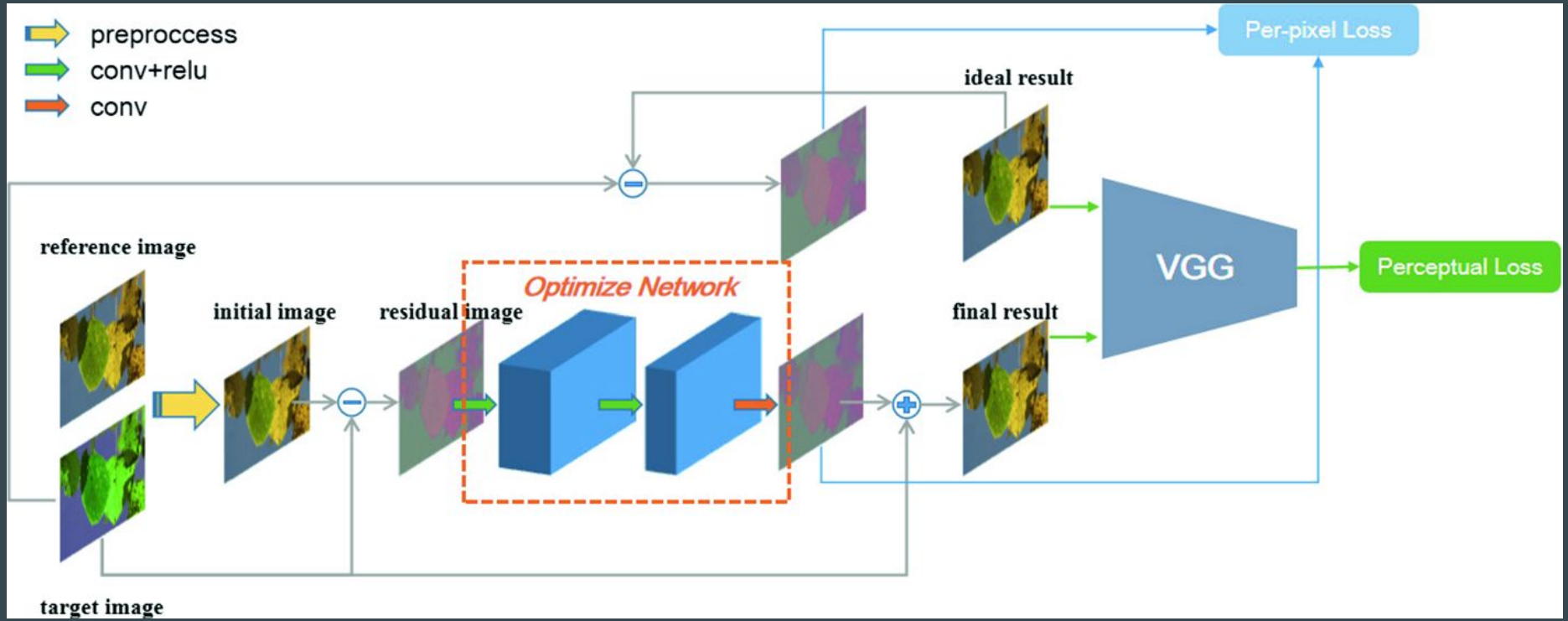


Uses VGG16, StyleGAN2

Trained on ResNet (also an option to train on EfficientNet)

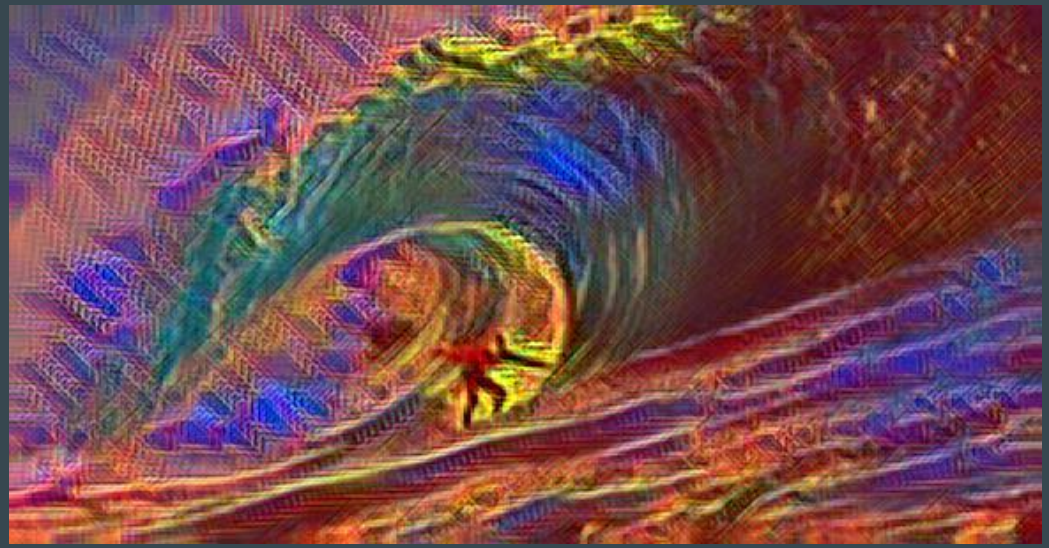
Loss functions:

- VGG
- logcosh
- MS-SIM
- LPIPS (default)


preproccess
conv+relu
conv
Per-pixel Loss
ideal result
reference image
Optimize Network
initial image
residual image
final result
VGG
Perceptual Loss
target image

6,000 iterations

10,000 iterations



2,000 iterations

Starry Night is most commonly used because it has good style properties

+

=

Content

Style

Result

https://medium.com/@build_it_for_fun/neural-style-transfer-with-swift-for-tensorflow-b8544105b854

Neural Style Transfer

Hyperparameters (default values listed)

epochs: 1
batch_size: 4
λ_content: 1e5
λ_style: 1e10
learning_rate: 0.001
checkpoint_interval: 1000
sample_interval: 500

https://github.com/jcjohnson/fast-neural-style

Training

FFHQ faces dataset. Sample of 20,000 pictures from entire set of ~168,000. Usually stopped training around 10,000 as further improvements from here were minimal.

Here are some of the pictures used as "styles" to train on: