Style Transfer 이야기

쎄트렉아이 신기술연구팀 전승현

간단한 소개

- 쎄트렉아이 신기술연구팀 연구원
- 딥러닝과 컴퓨터 비전, 그리고 여러 프로그래밍과 관련된 지식에 흥미
- 끊임없이 하고 싶은걸 배우는 것이 목표

간단한 소개

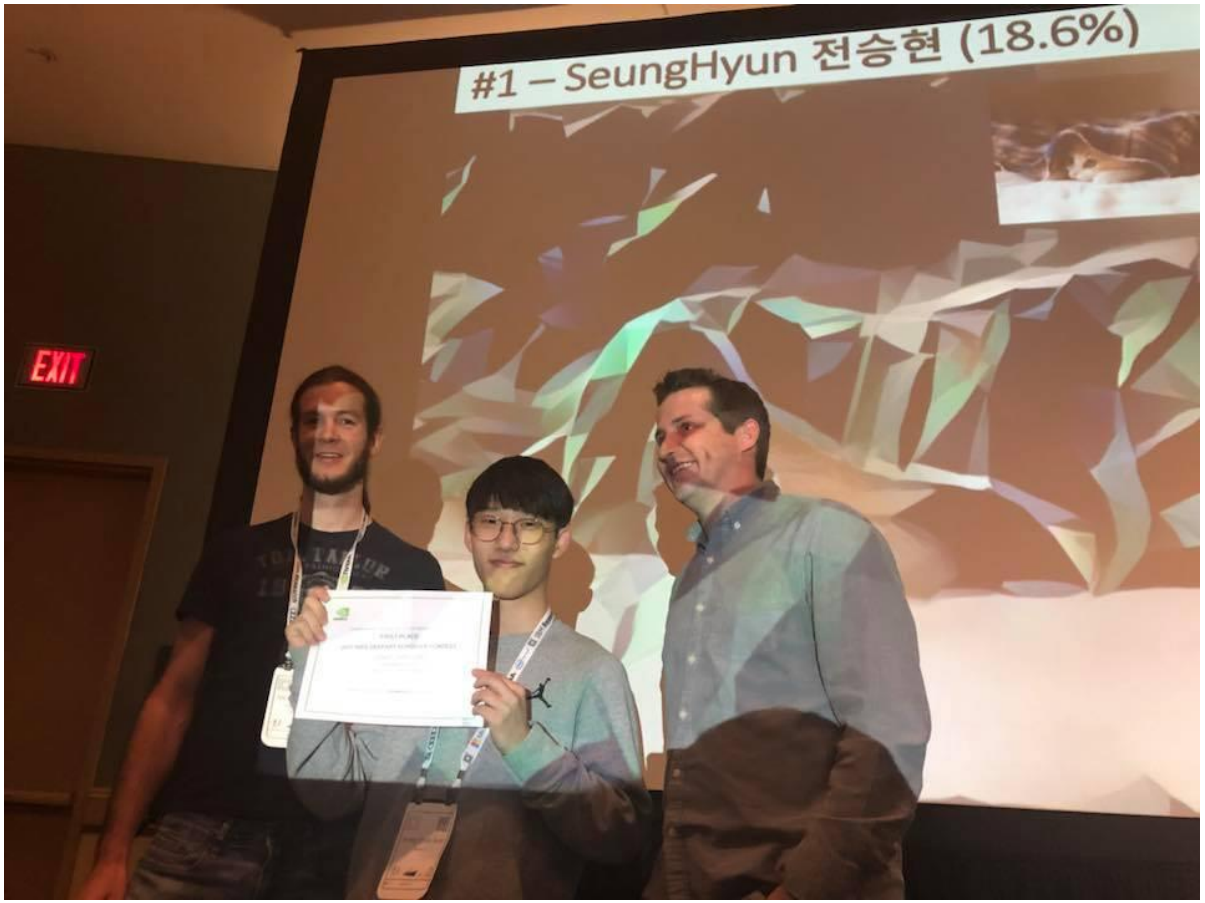
대한민국 국방부
Ministry of National Defense


@FuZer


@shtowever

간단한 소개

간단한 소개



목차

1. Style Transfer 그게 뭔가요?
2. 여러 종류의 Style Transfer
3. Application Style Transfer
4. 예술과 딥러닝 그 사이

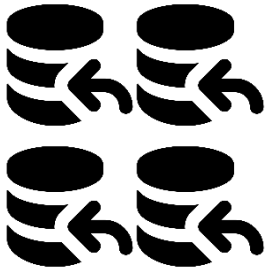
오늘 시간을 통해

- Style Transfer 분야에 대한 흥미와 지식
- Style Transfer 활용 분야
- 집으로 돌아가서 공부해볼 거리

사전지식

$x * \square = y$

$y - y'$



{x' : y'}

Backpropagation!

사전지식

$x * \square = y$

"magically make them work on your data"

$y - y'$

{x' : y'}

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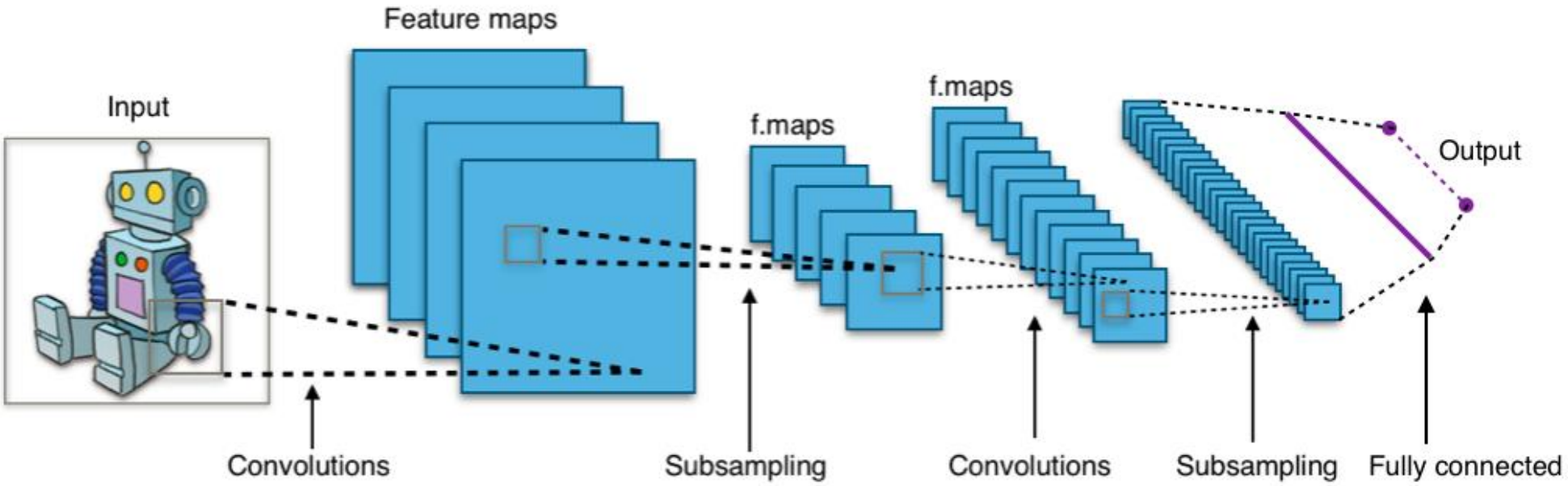
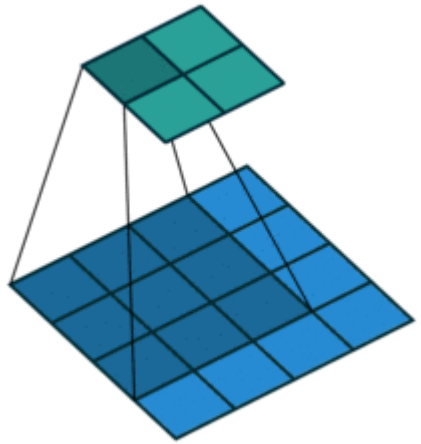
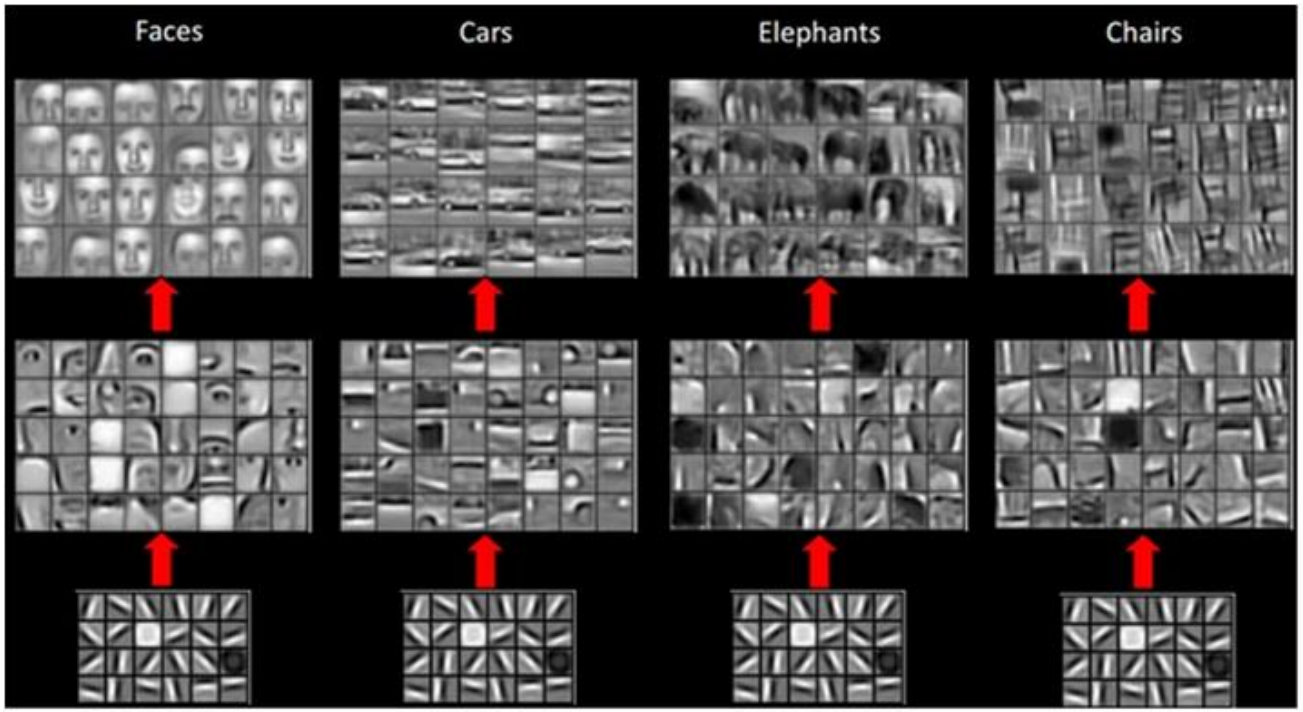

Feature maps
Input
f.maps
f.maps
Output
Convolutions
Subsampling
Convolutions
Subsampling
Fully connected

사전지식

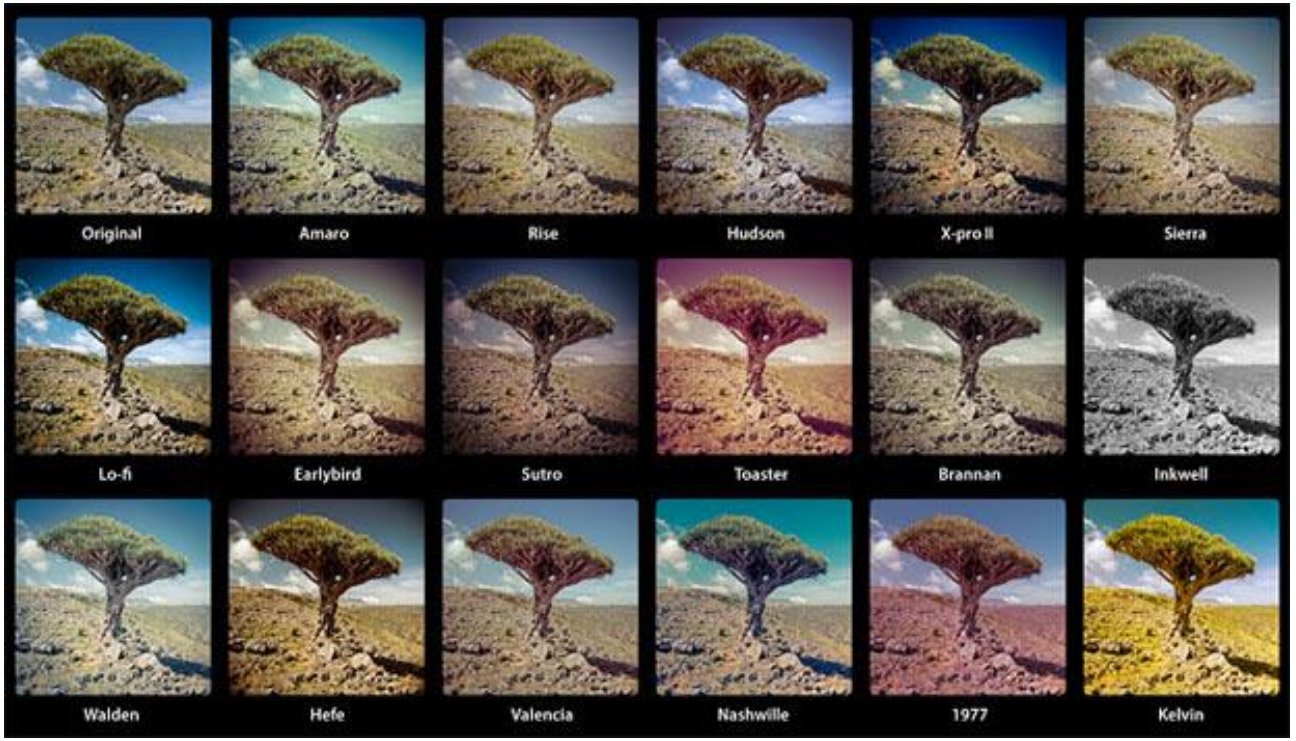


사전지식

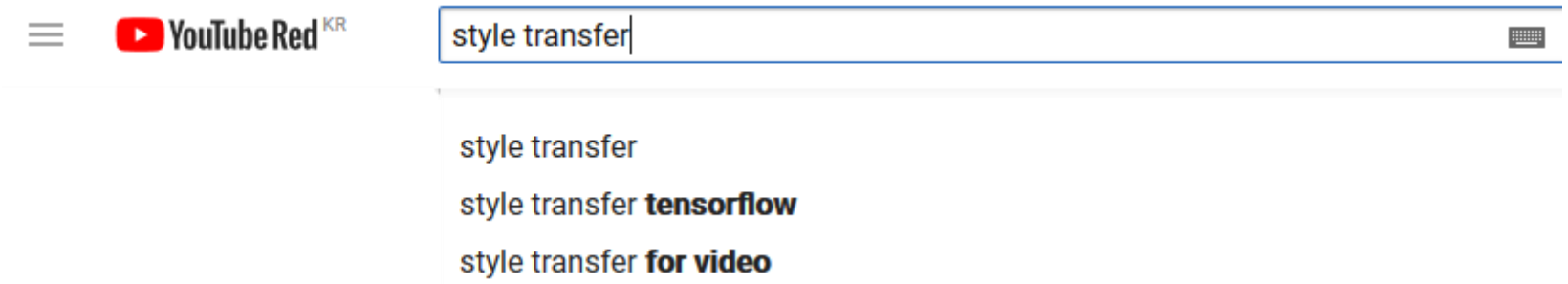


Style Transfer 그게 뭔가요?

인스타그램 필터랑 같은건가요?



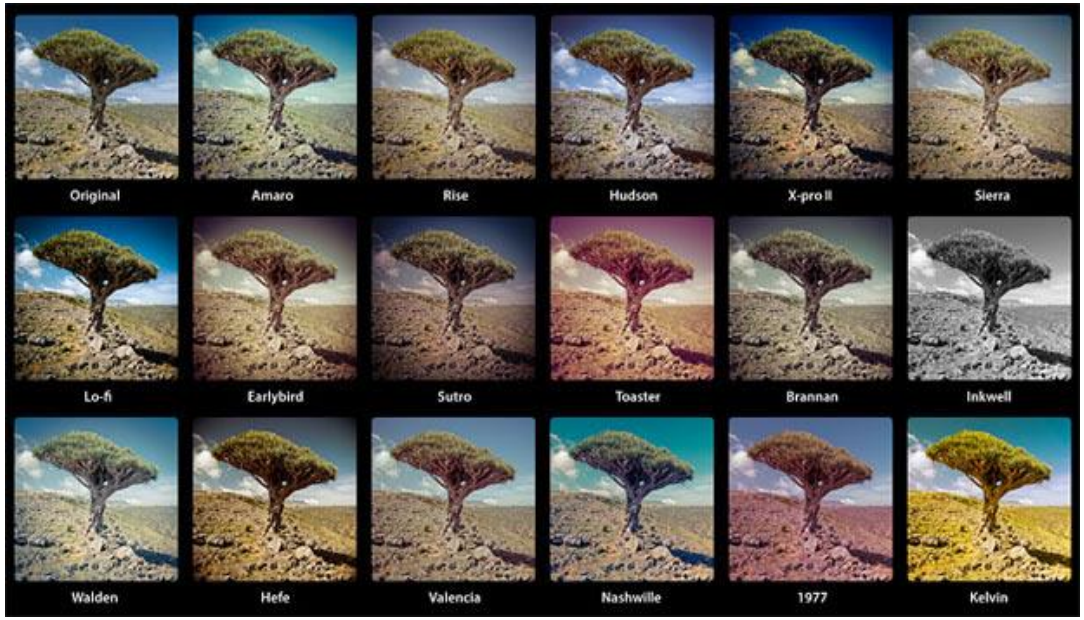
몰라서 YouTube에 검색해보니..



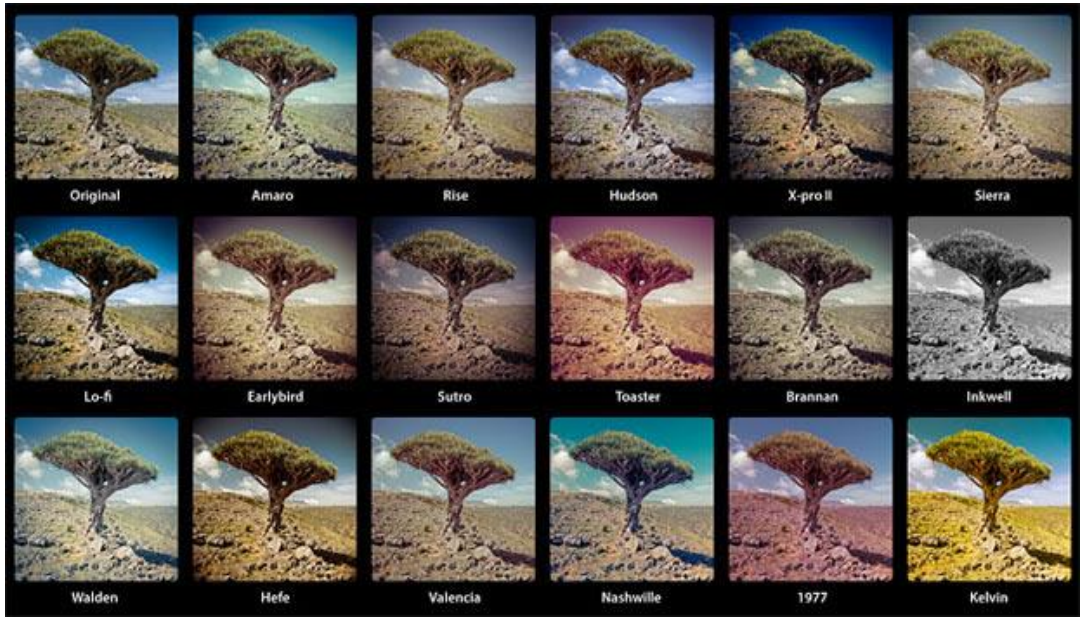
https://youtu.be/ZIwy2pqIFG4

https://youtu.be/xVJwwWQlQ1o

인스타그램 필터랑 같은건가요?



인스타그램 필터랑 같은건가요?



기존 이미지의 형상은 유지

스타일은 내가 원하는 스타일로

인스타그램 필터랑 같은건가요?

의 형상은 유지

가 원하는 스타일로

Content + New Style = ?

Content Image

Content + New Style = ?

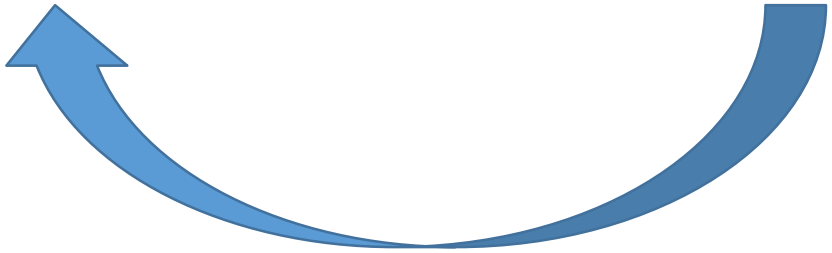
Content Image

Style Image

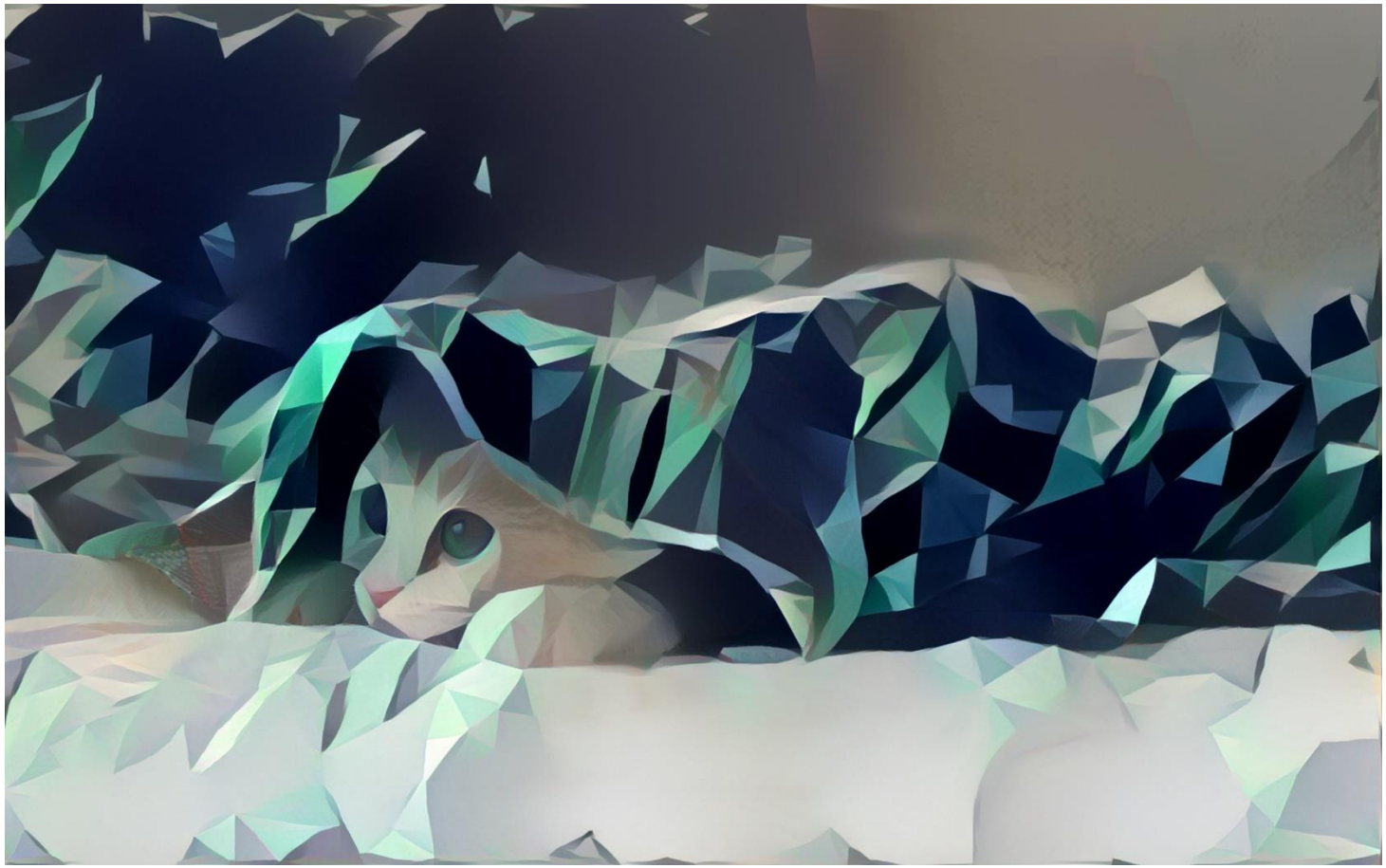
Content + New Style = ?

Content Image

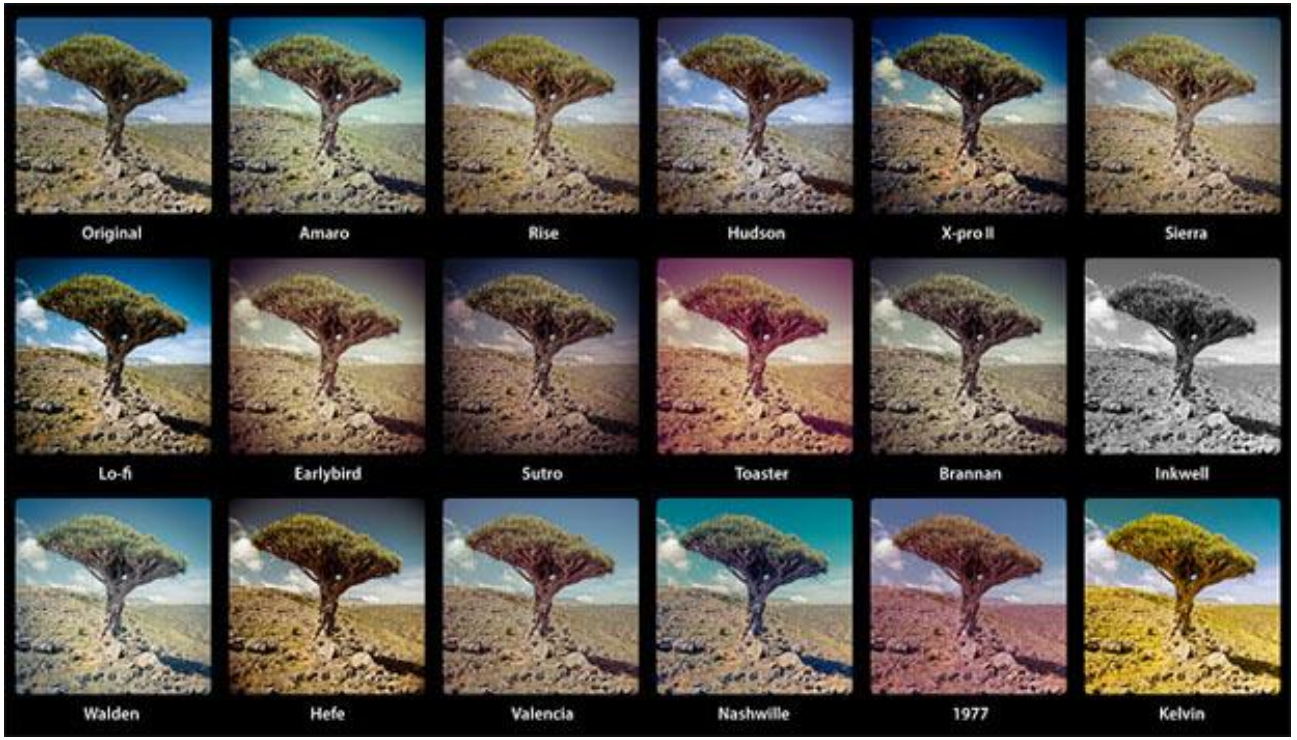
Style Image



Content + New Style = !

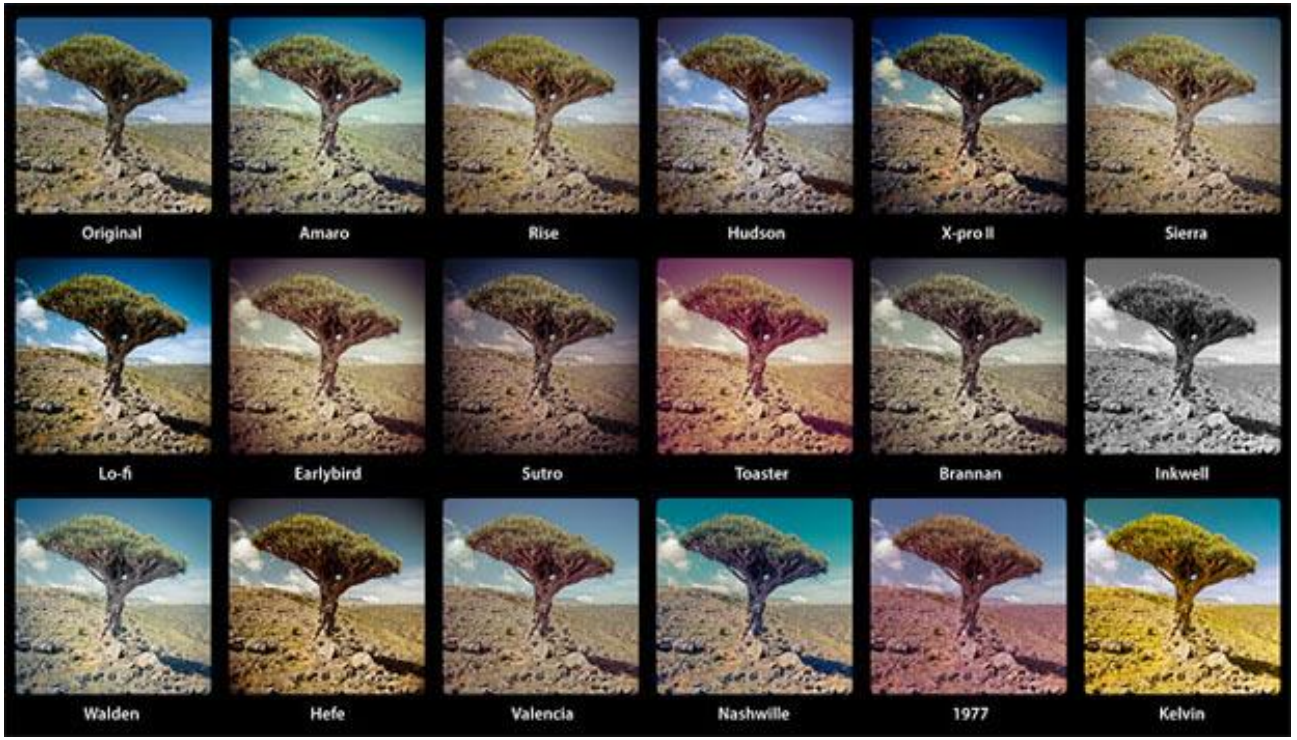


인스타그램 필터랑 살짝 다른거 같은데요?



Style Image

인스타그램 필터랑 살짝 다른거 같은데요?



어떻게 그런 것이 가능하죠?

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A Taxonomy of Style Transfer Method

- Image Iteration
  - MMD-based
  - MRF-based
- Model Iteration

http://arxiv.org/abs/1705.04058

어떻게 이미지의 형상을 유지하지?

Understanding Deep Image Representations by Inverting Them

Aravindh Mahendran
University of Oxford

Andrea Vedaldi
University of Oxford

https://arxiv.org/abs/1412.0035

이미지 컨텐츠 정보를 재구성

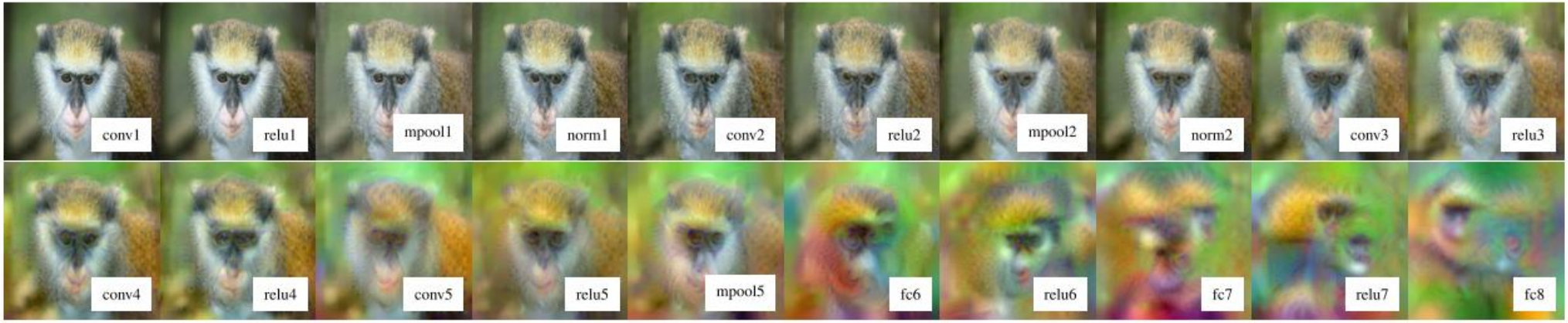

Figure 6. **CNN reconstruction.** Reconstruction of the image of Fig. 5.a from each layer of CNN-A. To generate these results, the regularization coefficient for each layer is chosen to match the highlighted rows in table 3. This figure is best viewed in color/screen.

https://arxiv.org/abs/1412.0035

이미지 컨텐츠 정보를 재구성

$$\mathbf{x}^* = \underset{\mathbf{x} \in \mathbb{R}^{H \times W \times C}}{\operatorname{argmin}} \ell(\Phi(\mathbf{x}), \Phi_0) + \lambda \mathcal{R}(\mathbf{x}) \qquad (1)$$

https://arxiv.org/abs/1412.0035

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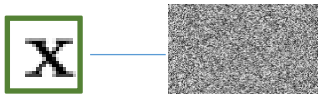

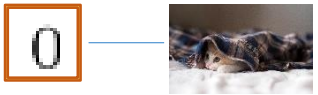

https://arxiv.org/abs/1412.0035

이미지 컨텐츠 정보를 재구성

두 이미지 간의 차이

$$\mathbf{x}^* = \underset{\mathbf{x} \in \mathbb{R}^{H \times W \times C}}{\operatorname{argmin}} \ell(\Phi(\mathbf{x}), \Phi_0) + \lambda \mathcal{R}(\mathbf{x}) \qquad (1)$$

https://arxiv.org/abs/1412.0035

이미지 컨텐츠 정보를 재구성

두 이미지 간의 차이

Regularizer

$$\mathbf{x}^* = \underset{\mathbf{x} \in \mathbb{R}^{H \times W \times C}}{\operatorname{argmin}} \ell(\Phi(\mathbf{x}), \Phi_0) + \lambda \mathcal{R}(\mathbf{x}) \qquad (1)$$

최소화 하는 이미지 x

https://arxiv.org/abs/1412.0035

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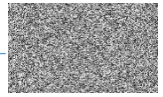
$\mathbf{x}$ 

학습 전

0 

https://arxiv.org/abs/1412.0035

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학습 후

0 

https://arxiv.org/abs/1412.0035

어떻게 그런 것이 가능하죠?

- 어떻게 이미지의 형상을 유지하지? - O
- 이미지에서 스타일을 어떻게 뽑아내지?

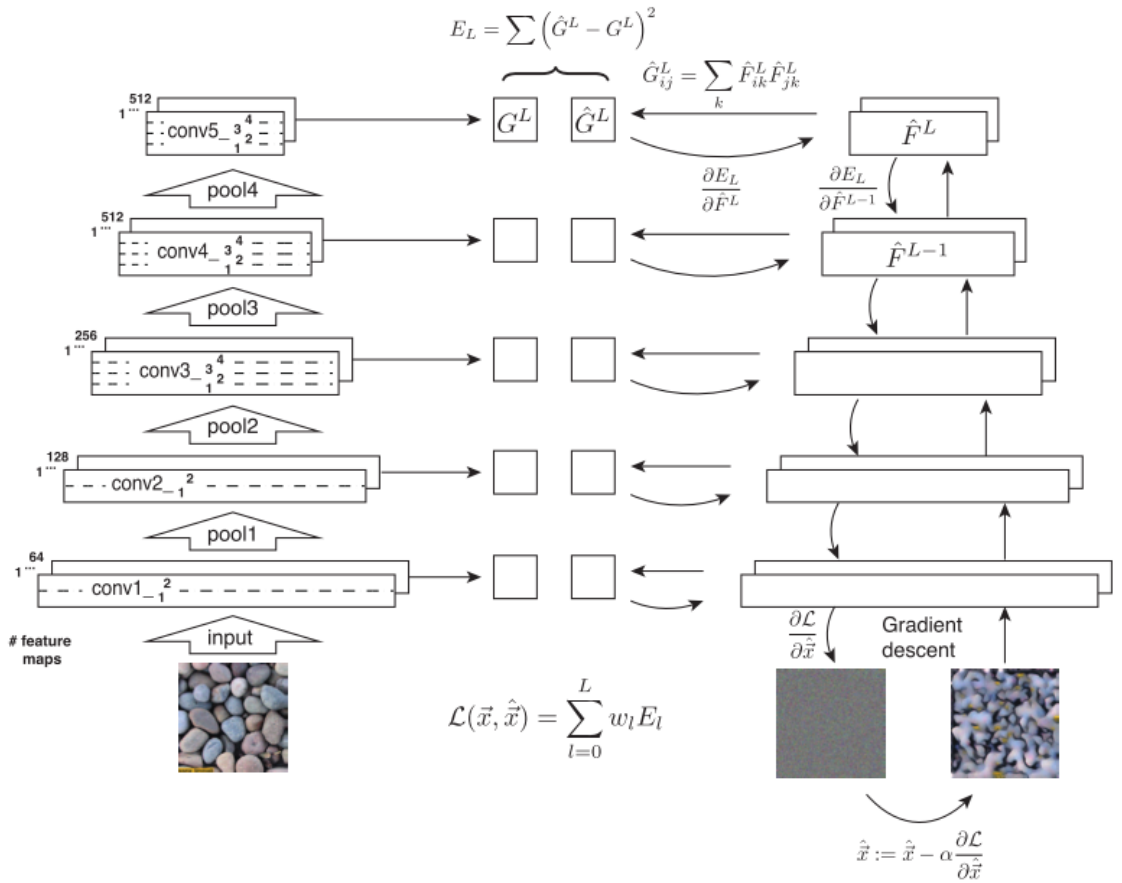
이미지에서 스타일을 어떻게 뽑아내지?

Texture Synthesis Using Convolutional Neural Networks

Leon A. Gatys
Centre for Integrative Neuroscience, University of Tübingen, Germany
Bernstein Center for Computational Neuroscience, Tübingen, Germany
Graduate School of Neural Information Processing, University of Tübingen, Germany
leon.gatys@bethgelab.org

https://arxiv.org/abs/1505.07376

이미지에서 스타일을 어떻게 뽑아내지?



$$\hat{G}^L_{ij} = \sum_k \hat{F}^L_{ik}\hat{F}^L_{jk}$$

$$E_L = \sum \left(\hat{G}^L - G^L\right)^2$$

$$\mathcal{L}(\vec{x}, \hat{\vec{x}}) = \sum_{l=0}^{L} w_l E_l$$

https://arxiv.org/abs/1505.07376

이미지에서 스타일을 어떻게 뽑아내지?

https://arxiv.org/abs/1505.07376

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A Neural Algorithm of Artistic Style

A Neural Algorithm of Artistic Style

Leon A. Gatys,[1,2,3*] Alexander S. Ecker,[1,2,4,5] Matthias Bethge[1,2,4]

[1]Werner Reichardt Centre for Integrative Neuroscience
and Institute of Theoretical Physics, University of Tübingen, Germany
[2]Bernstein Center for Computational Neuroscience, Tübingen, Germany

http://arxiv.org/abs/1508.06576

A Neural Algorithm of Artistic Style

처음 Neural Style Transfer라는
개념을 사용한 논문

http://arxiv.org/abs/1508.06576

A Neural Algorithm of Artistic Style

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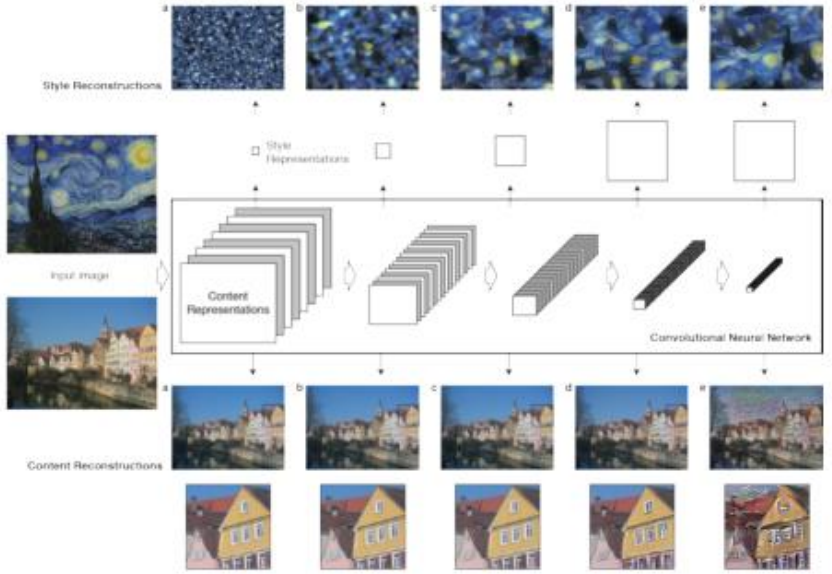

Figure 1: **Convolutional Neural Network (CNN)**. A given input image is represented as a set of filtered images at each processing stage in the CNN. While the number of different filters increases along the processing hierarchy, the size of the filtered images is reduced by some downsampling mechanism (e.g. max-pooling) leading to a decrease in the total number of units per layer of the network. **Content Reconstructions**. We can visualise the information

http://arxiv.org/abs/1508.06576

A Neural Algorithm of Artistic Style

처음 Neural Style Transfer라는
개념을 사용한 논문

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

http://arxiv.org/abs/1508.06576

A Neural Algorithm of Artistic Style

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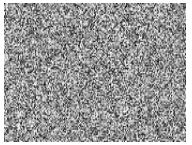
A Neural Algorithm of Artistic Style

$\vec{p}$

$\vec{a}$



$\vec{x}$

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

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A Neural Algorithm of Artistic Style

이미지 형상을 유지 스타일 정보를 같게

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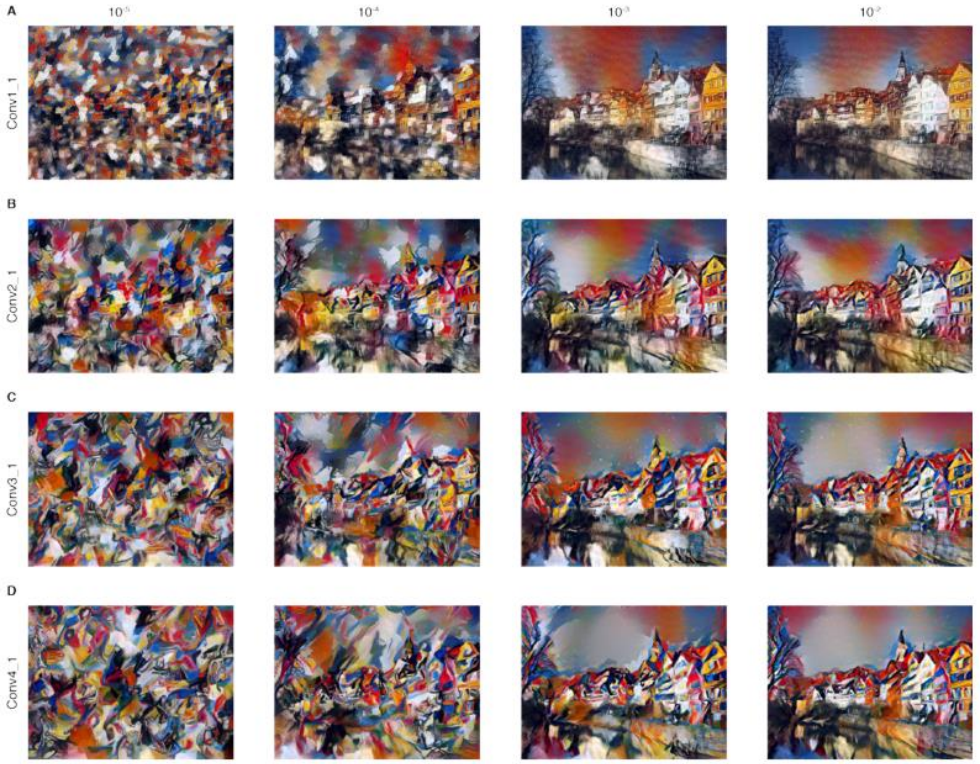
어느 정도로? (비율)

http://arxiv.org/abs/1508.06576

A Neural Algorithm of Artistic Style



http://arxiv.org/abs/1508.06576

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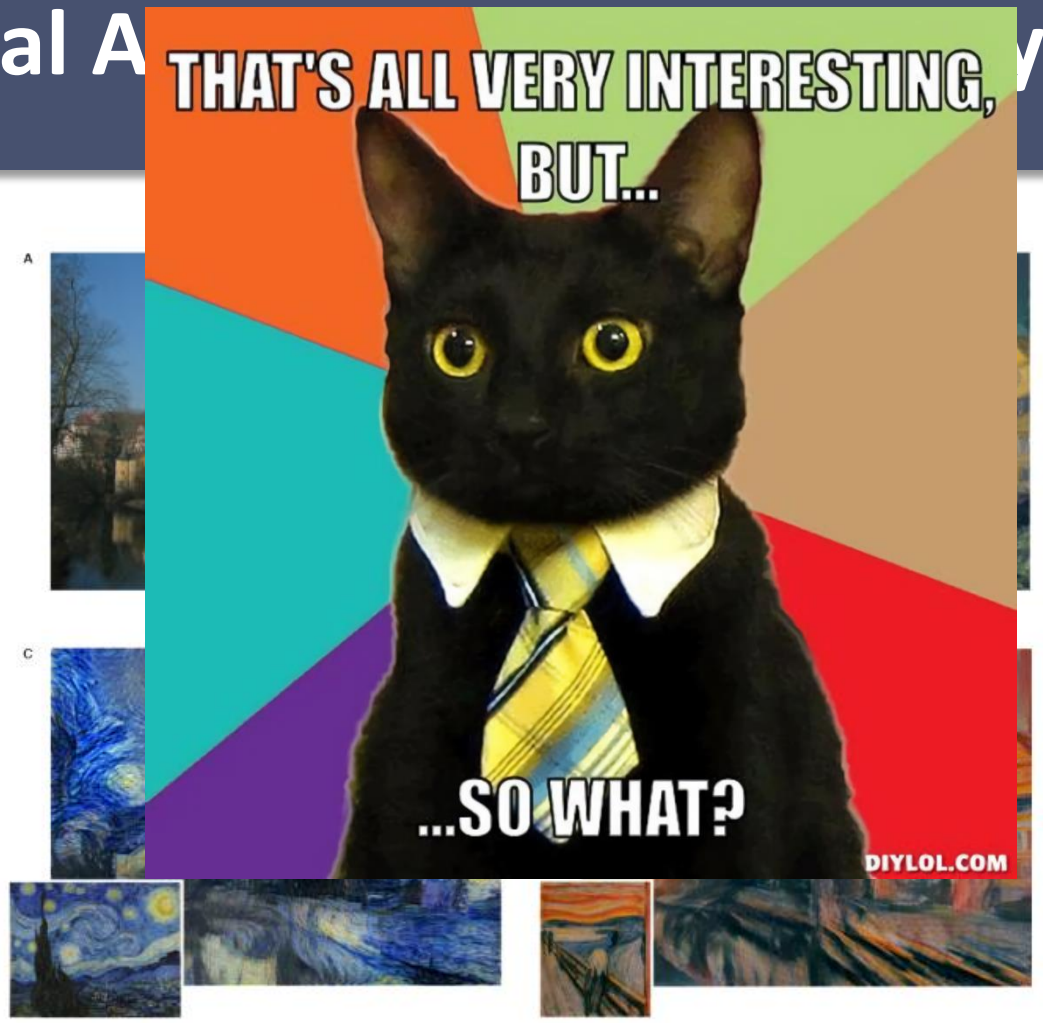
A Neural A yle



http://arxiv.org/abs/1508.06576

여러 종류의 Style Transfer

A Taxonomy of Style Transfer Method

- Image Iteration
  - MMD-based
  - MRF-based
- Model Iteration

http://arxiv.org/abs/1705.04058

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Markov Random Fields based

https://arxiv.org/abs/1601.04589

Markov Random Fields based

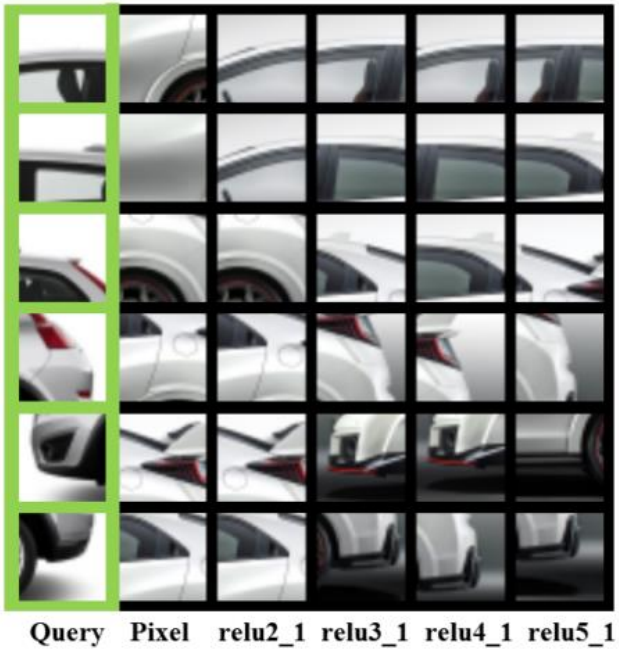

Figure 3: Comparison of patch matching at different layers of a VGG network.

https://arxiv.org/abs/1601.04589

Markov Random Fields based

https://arxiv.org/abs/1601.04589

Can it be applied to video?

https://giphy.com/gifs/art-tech-coding-tY1nqCfIjweGI

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“Fast” Neural Style Transfer

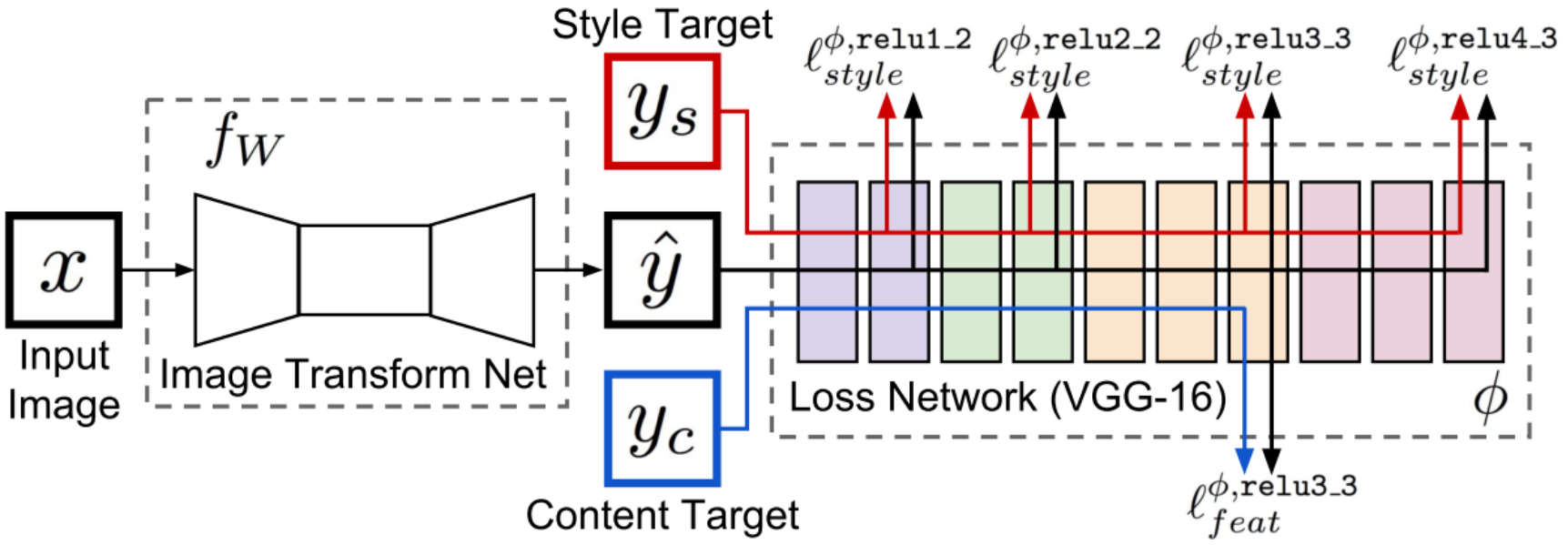
Perceptual Losses for Real-Time Style Transfer and Super-Resolution

Justin Johnson, Alexandre Alahi, Li Fei-Fei
{jcjohns, alahi, feifeili}@cs.stanford.edu

Department of Computer Science, Stanford University

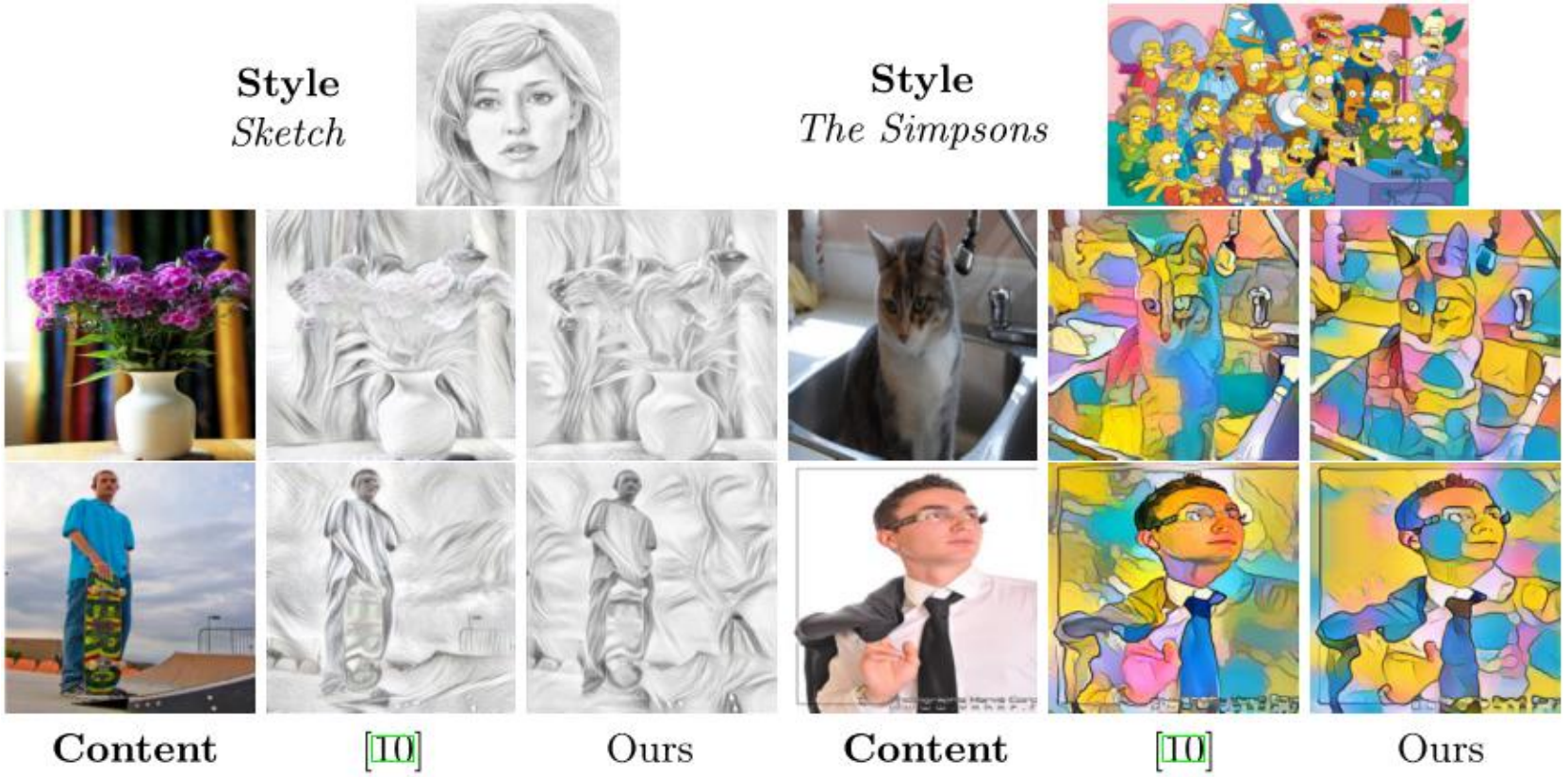
https://arxiv.org/abs/1603.08155

“Fast” Neural Style Transfer



https://arxiv.org/abs/1603.08155

“Fast” Neural Style Transfer



https://arxiv.org/abs/1603.08155

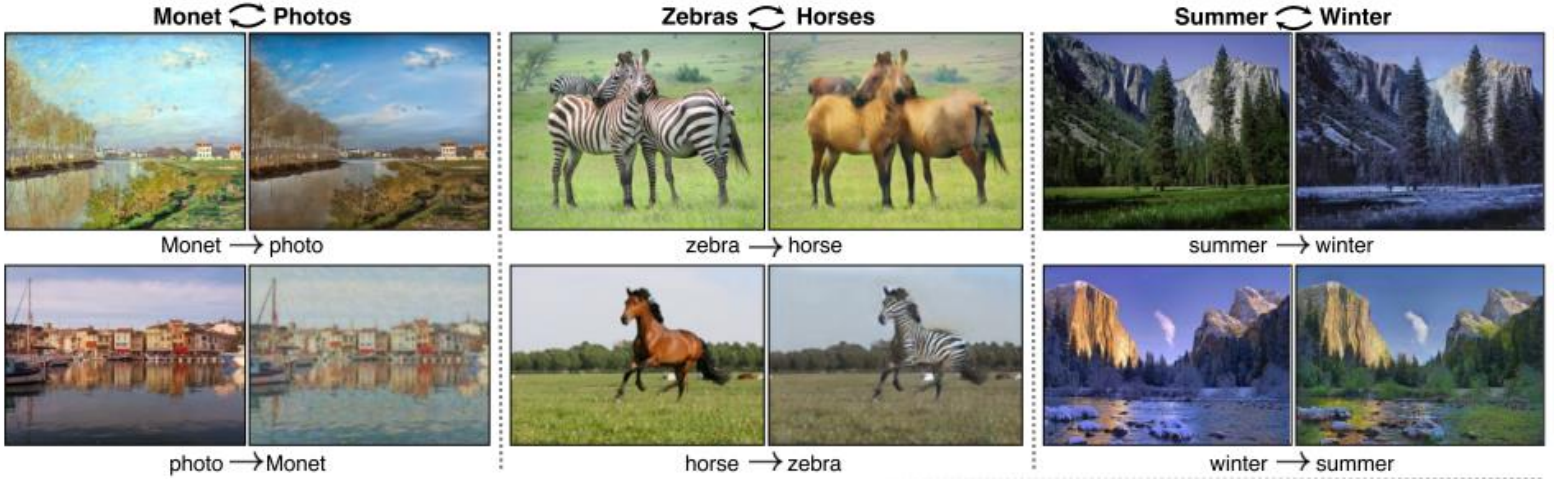
Cycle GAN

https://arxiv.org/abs/1703.10593

Cycle GAN

Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks

Jun-Yan Zhu* Taesung Park* Phillip Isola Alexei A. Efros
Berkeley AI Research (BAIR) laboratory, UC Berkeley



https://arxiv.org/abs/1703.10593

Cycle GAN is a follow up to Pix2Pix

Image-to-Image Translation with Conditional Adversarial Networks

Phillip Isola Jun-Yan Zhu Tinghui Zhou Alexei A. Efros

Berkeley AI Research (BAIR) Laboratory, UC Berkeley

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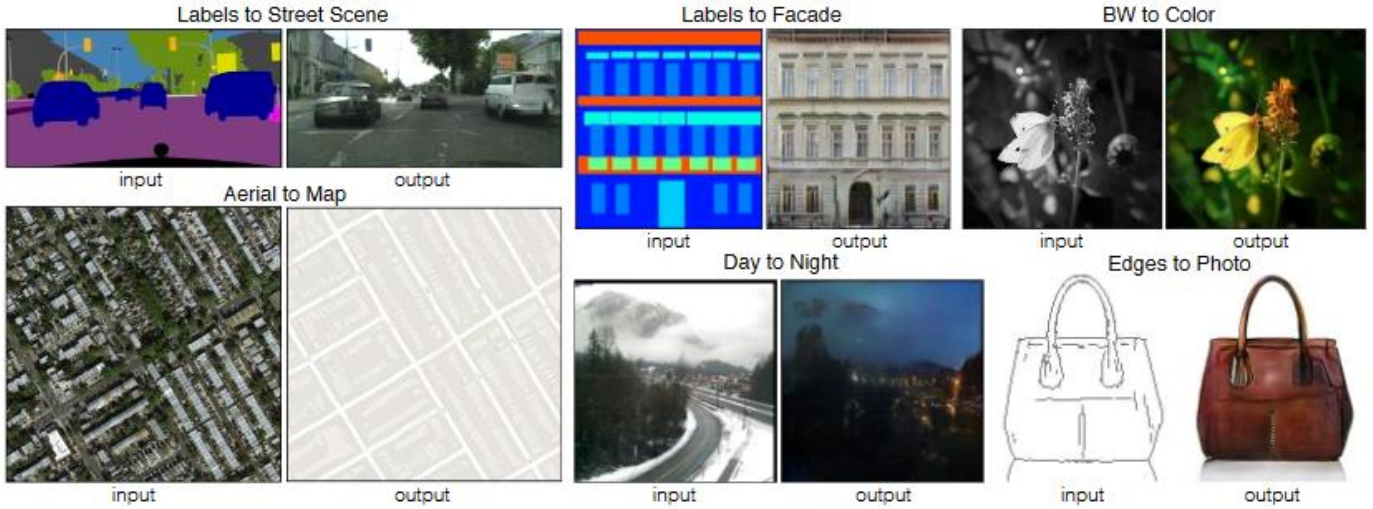
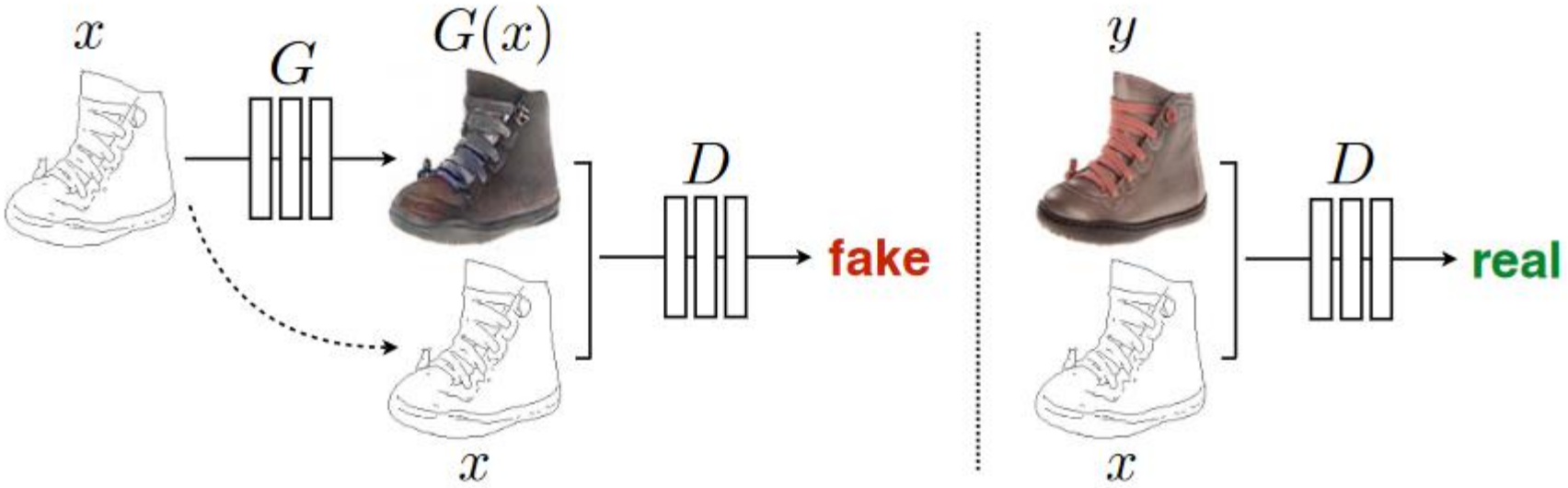


https://arxiv.org/abs/1611.07004

Pix2Pix



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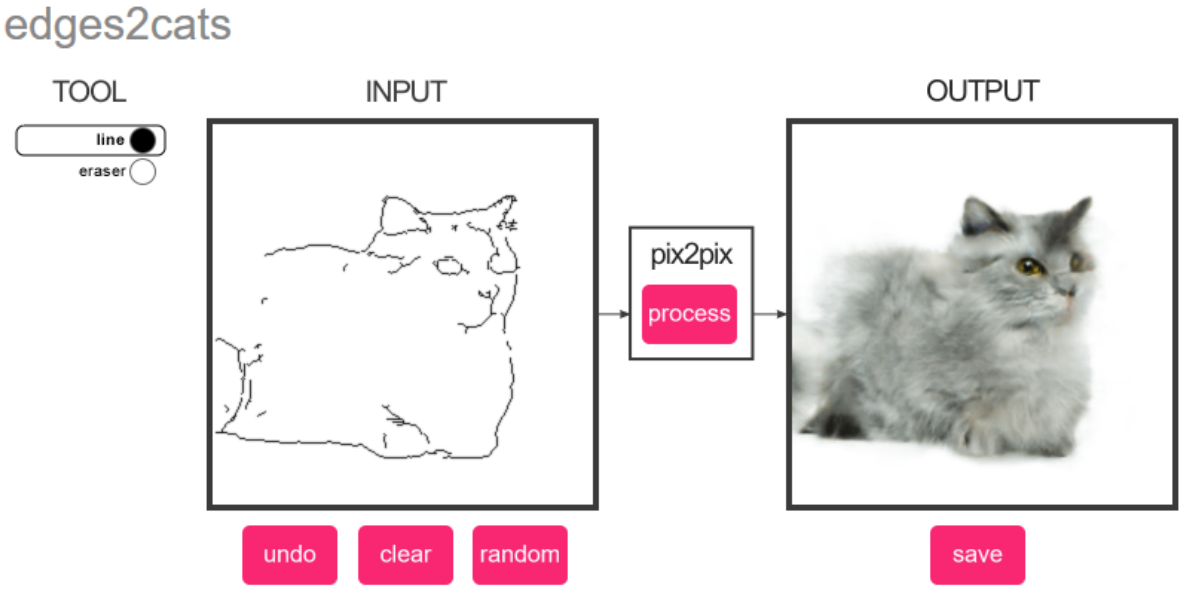
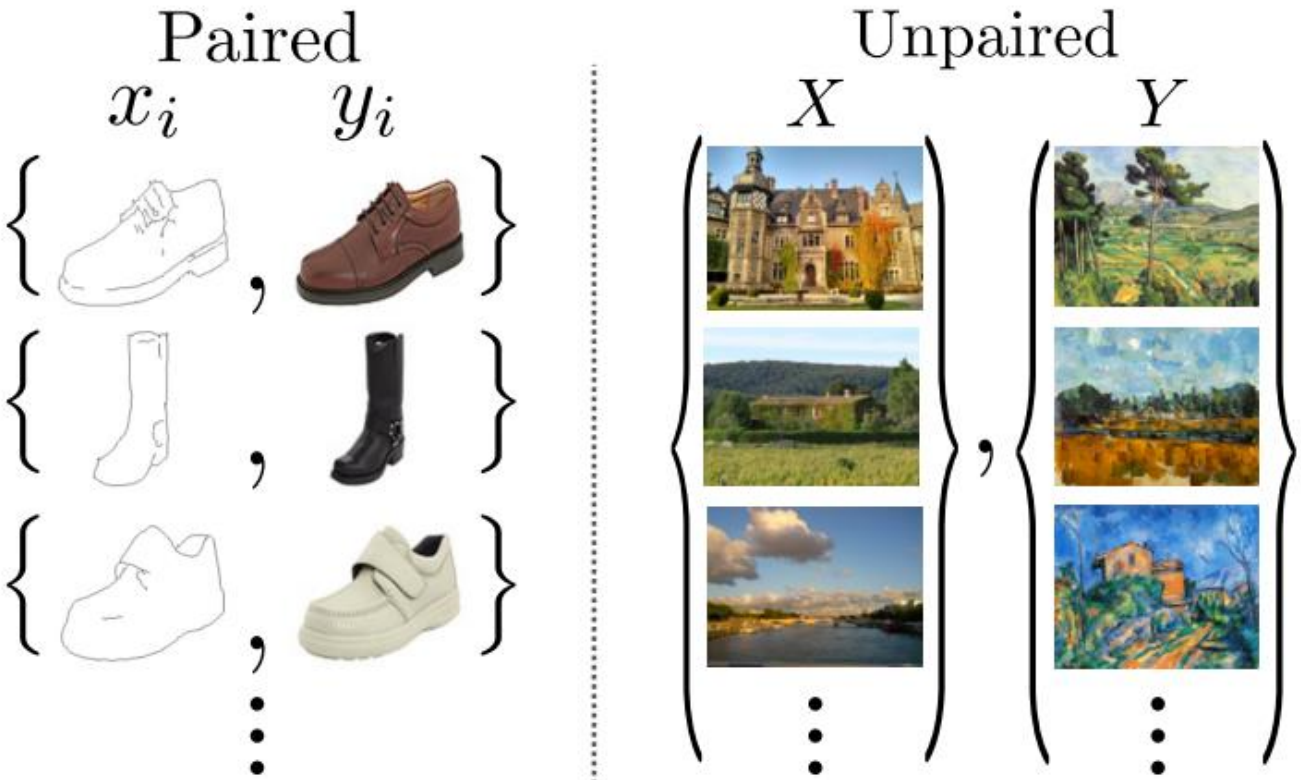
Pix2Pix



https://affinelayer.com/pixsrv/

Pix2Pix



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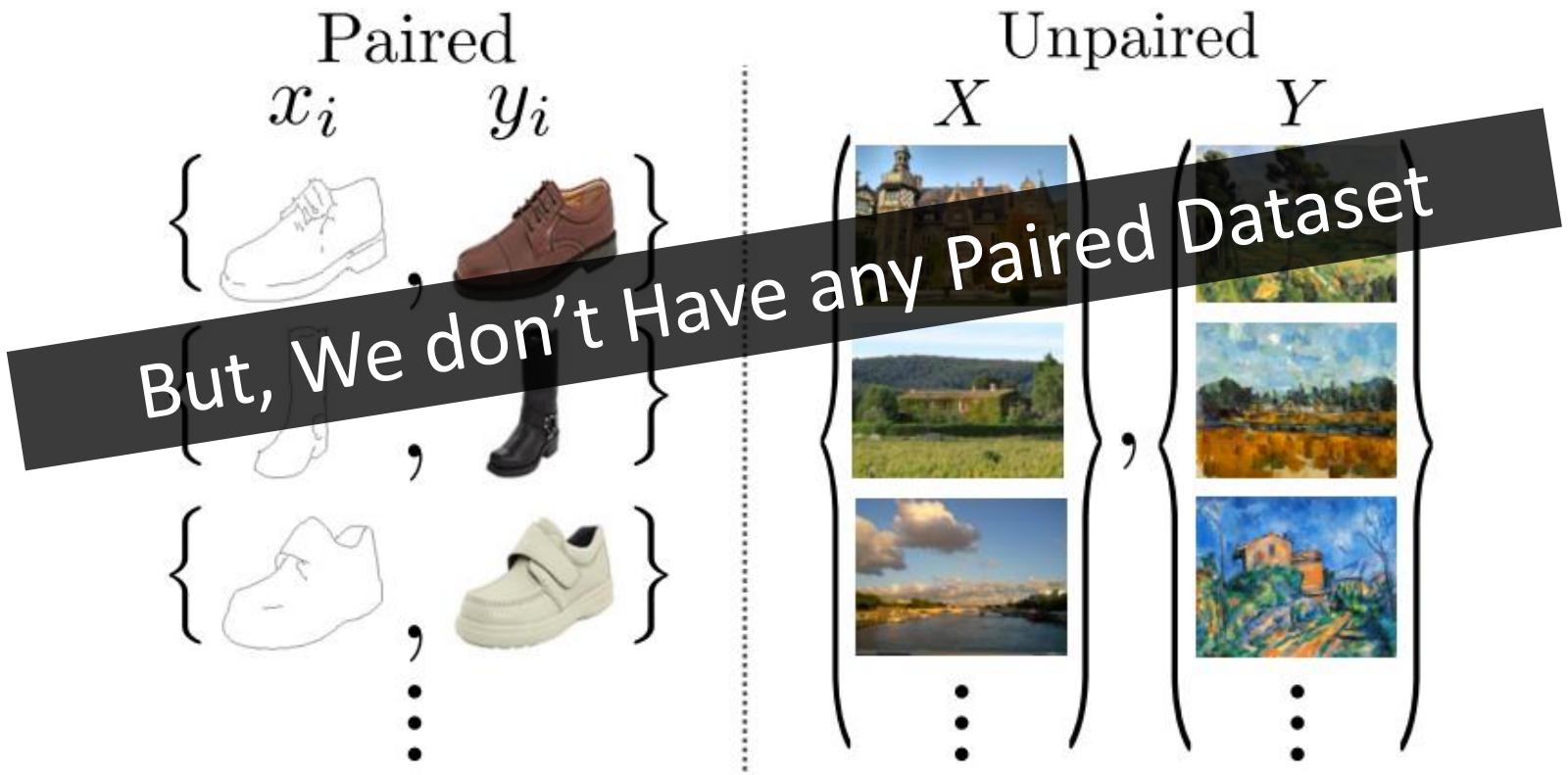
Pix2Pix



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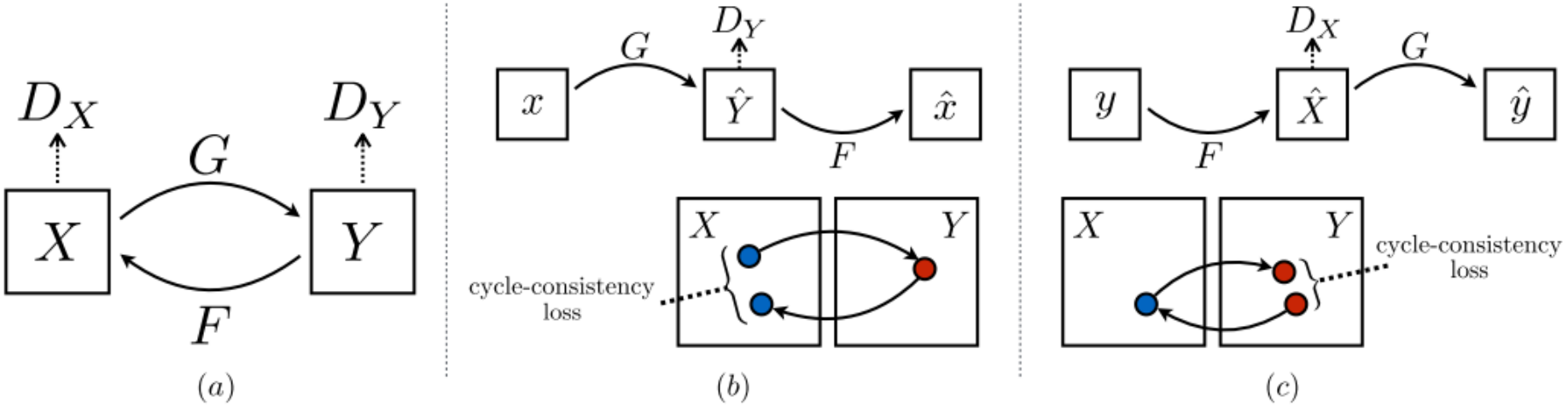
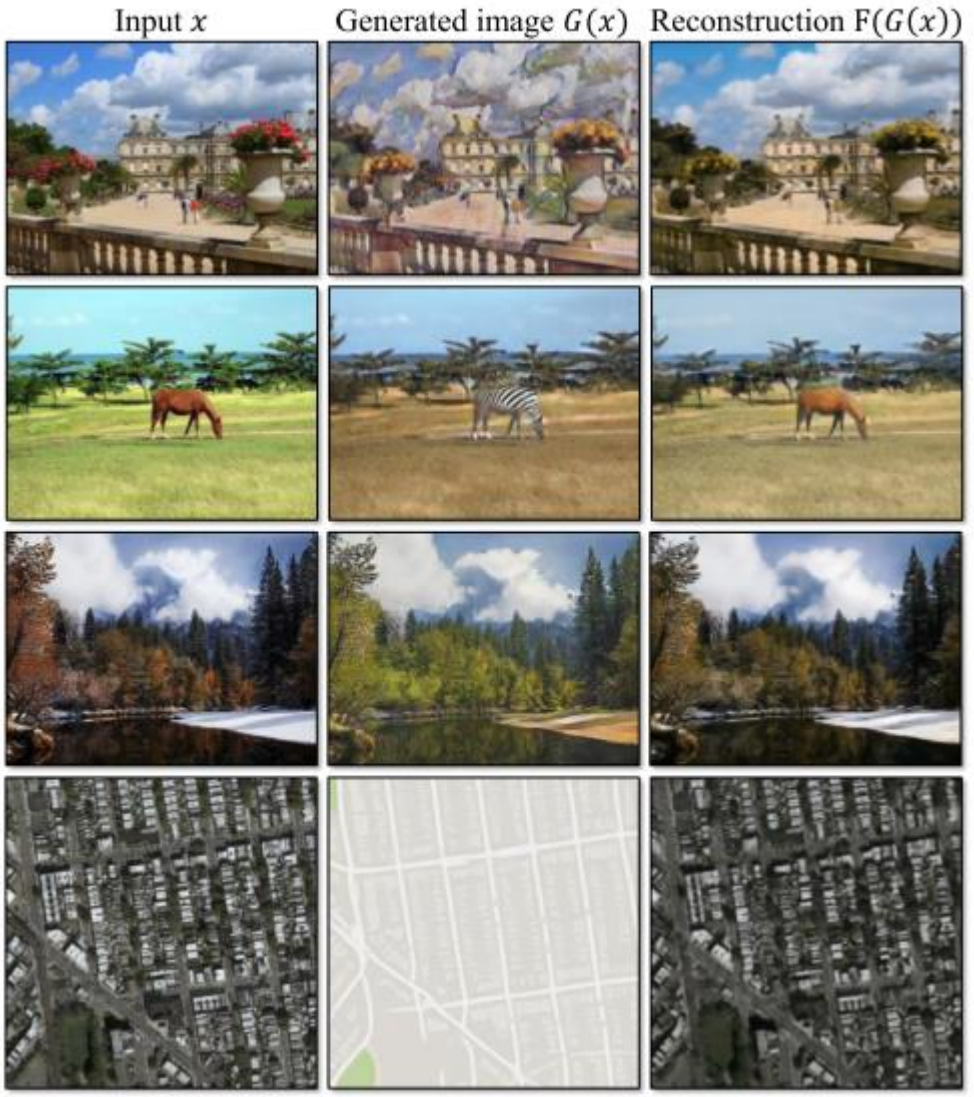
Cycle GAN



https://arxiv.org/abs/1703.10593

Cycle GAN



https://arxiv.org/abs/1703.10593

Cycle GAN

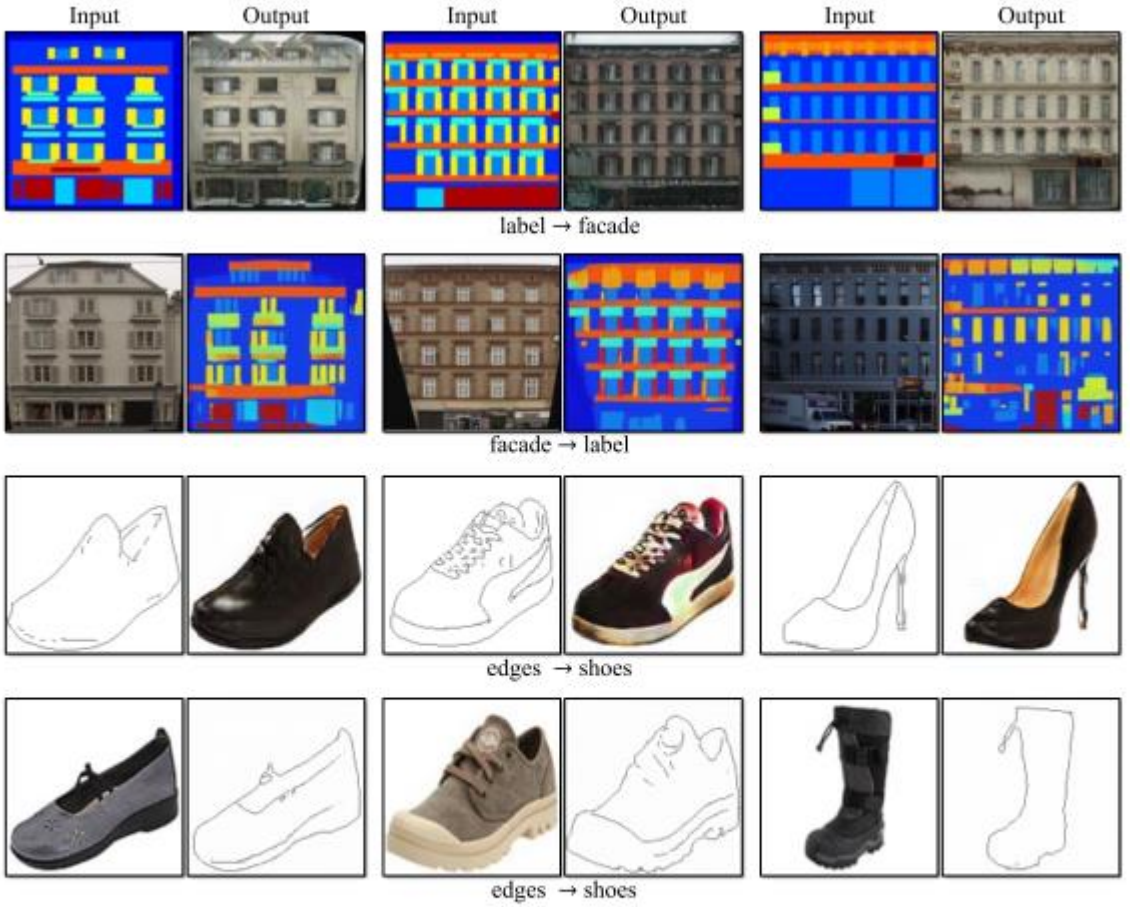


Figure 8: Example results of CycleGAN on paired datasets used in "pix2pix" [21] such as architectural labels↔photos and edges↔shoes.

https://arxiv.org/abs/1703.10593

Photorealistic Image Stylization

A Closed-form Solution to Photorealistic Image Stylization

Yijun Li[1], Ming-Yu Liu[2], Xueting Li[1], Ming-Hsuan Yang[1,2], and Jan Kautz[2]
[1]University of California, Merced [2]NVIDIA
{yli62,xli75,mhyang}@ucmerced.edu {mingyul,jkautz}@nvidia.com

(a) Content (b) Style (c) Gatys et al. [6] (d) Luan et al. [21] (e) Ours

http://arxiv.org/abs/1802.06474

Photorealistic Image Stylization

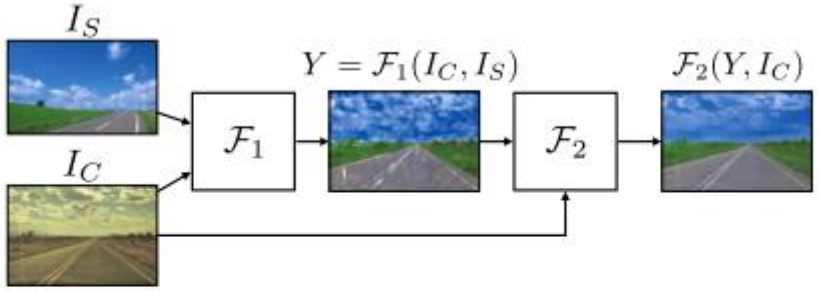
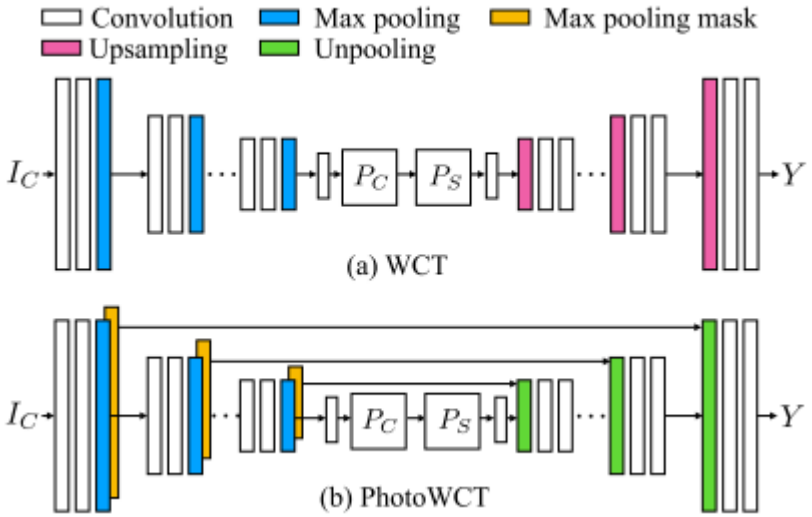


Figure 2: The proposed photorealistic image style transfer algorithm consists of two closed-form function mappings: $\mathcal{F}_1$ and $\mathcal{F}_2$. While $\mathcal{F}_1$ maps I_C to an intermediate image carrying the style of I_S, $\mathcal{F}_2$ removes noticeable artifacts and produces a photorealistic stylized result.



http://arxiv.org/abs/1802.06474

Photorealistic Image Stylization

(a) Content (b) Style (c) Pitié et al. [24] (d) Luan et al. [21] (e) Ours

http://arxiv.org/abs/1802.06474

Application Style Transfer

Instagram Filter

shtowever

shtowever 호주 또가고싶다

sbeinone, pack_won_jin, jjgkpp,
whitehorse_tcmn님이 좋아합니다

2016년 10월 16일

댓글 달기...

Style Transfer in Movie

Bringing Impressionism to Life with Neural Style Transfer in *Come Swim*

Bhautik J Joshi*
Research Engineer, Adobe

Kristen Stewart
Director, *Come Swim*

David Shapiro
Producer, Starlight Studios



https://arxiv.org/abs/1701.04928v1

Style Transfer in Movie

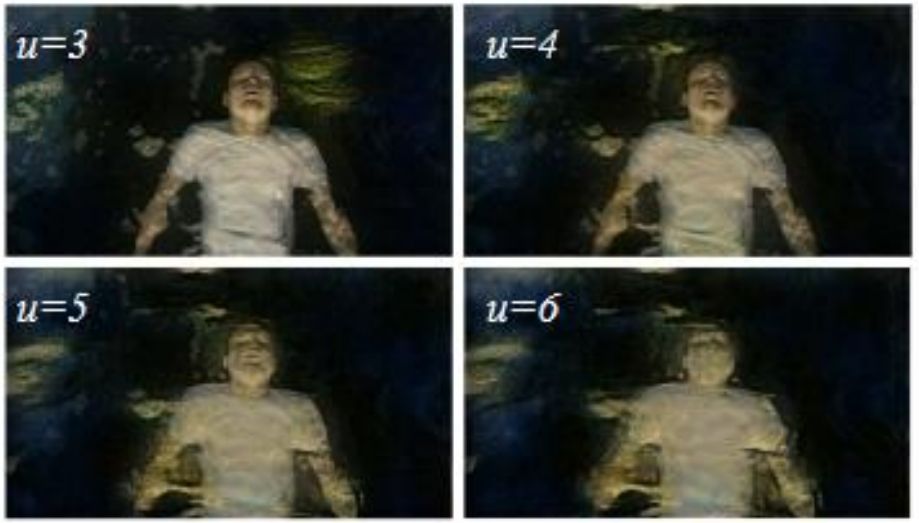
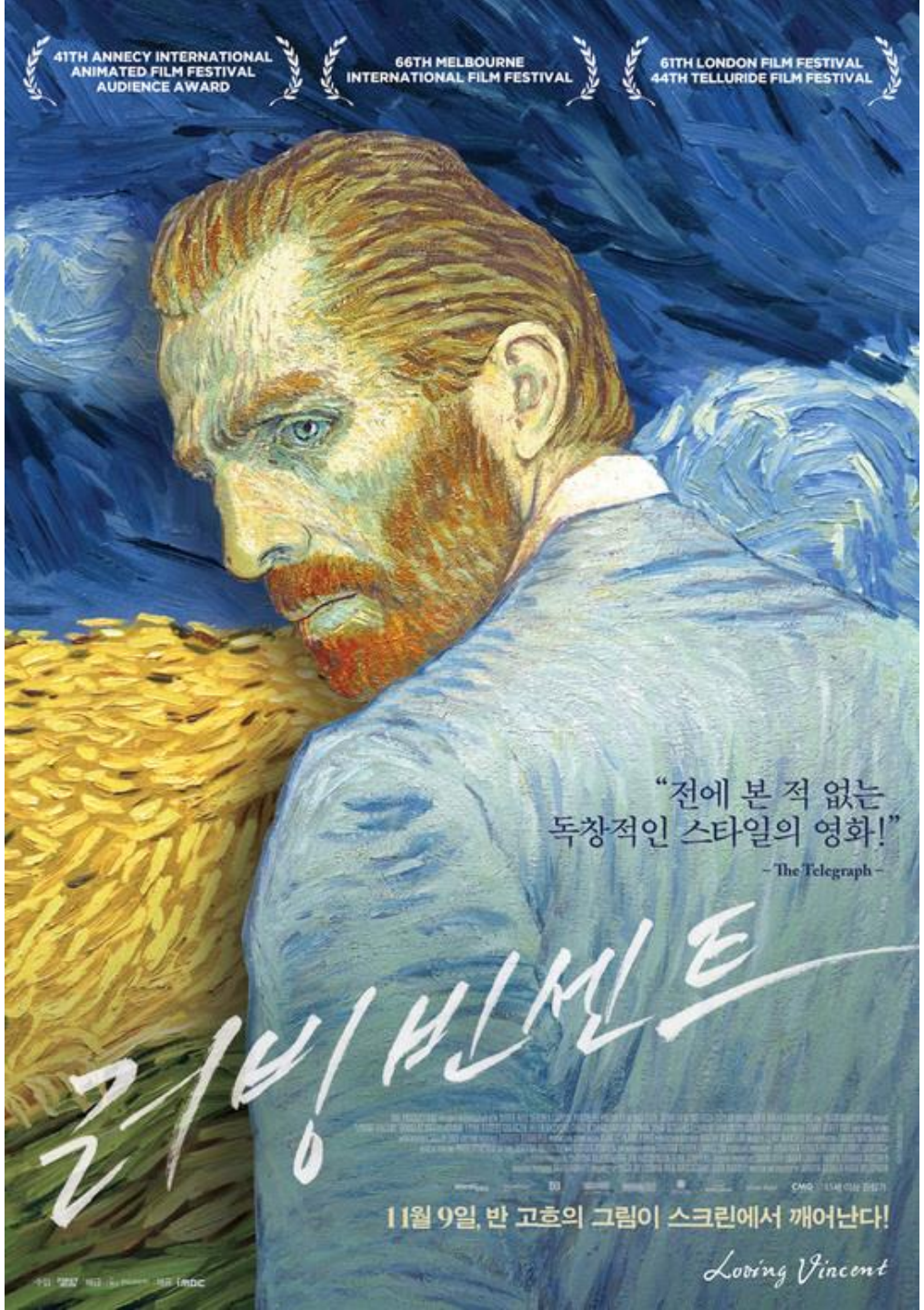
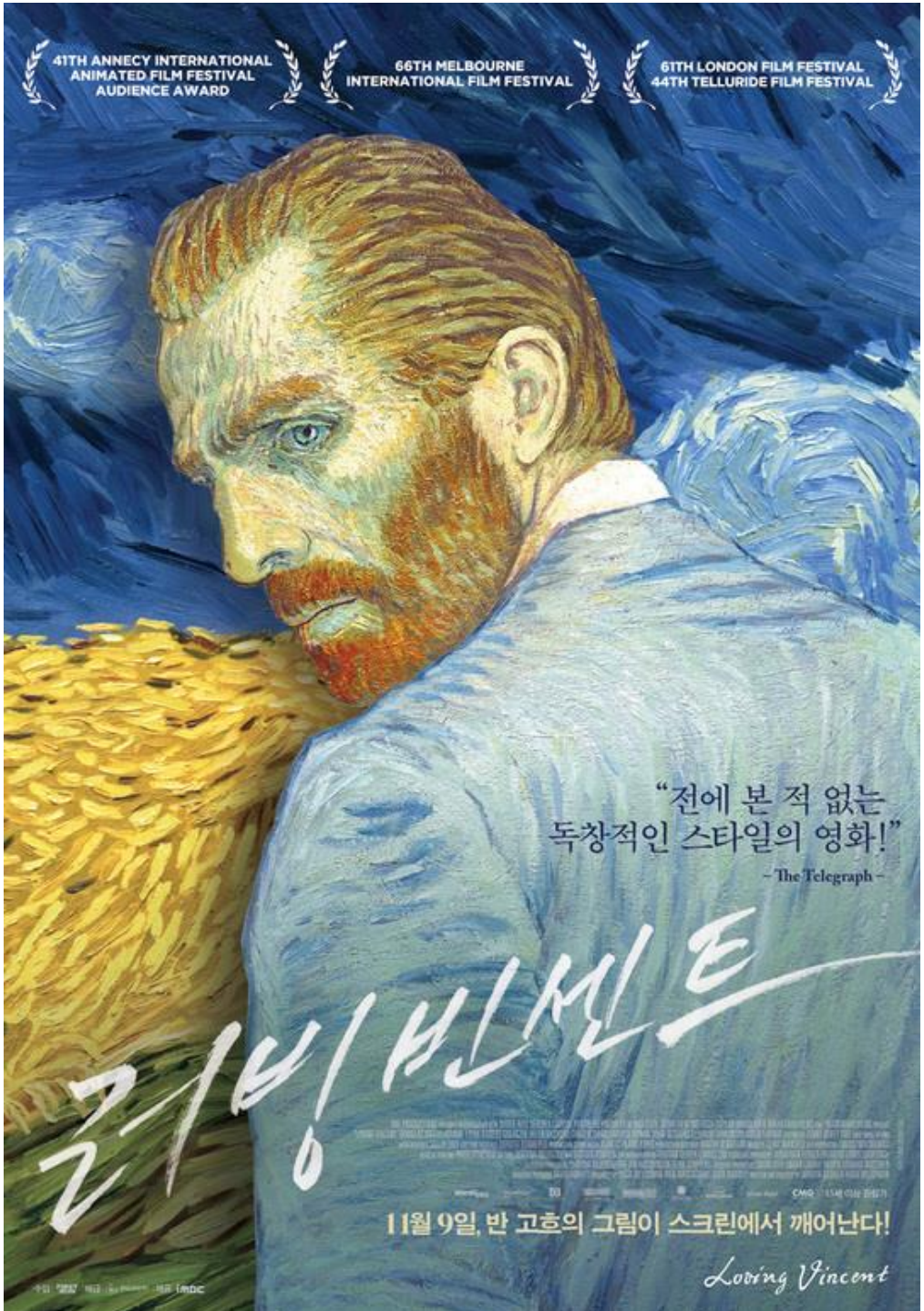


Figure 6: *Increasing the value of* ***u*** *gave us a control to fine-tune the degree of subjectively-measured impressionism present in the style transfer*

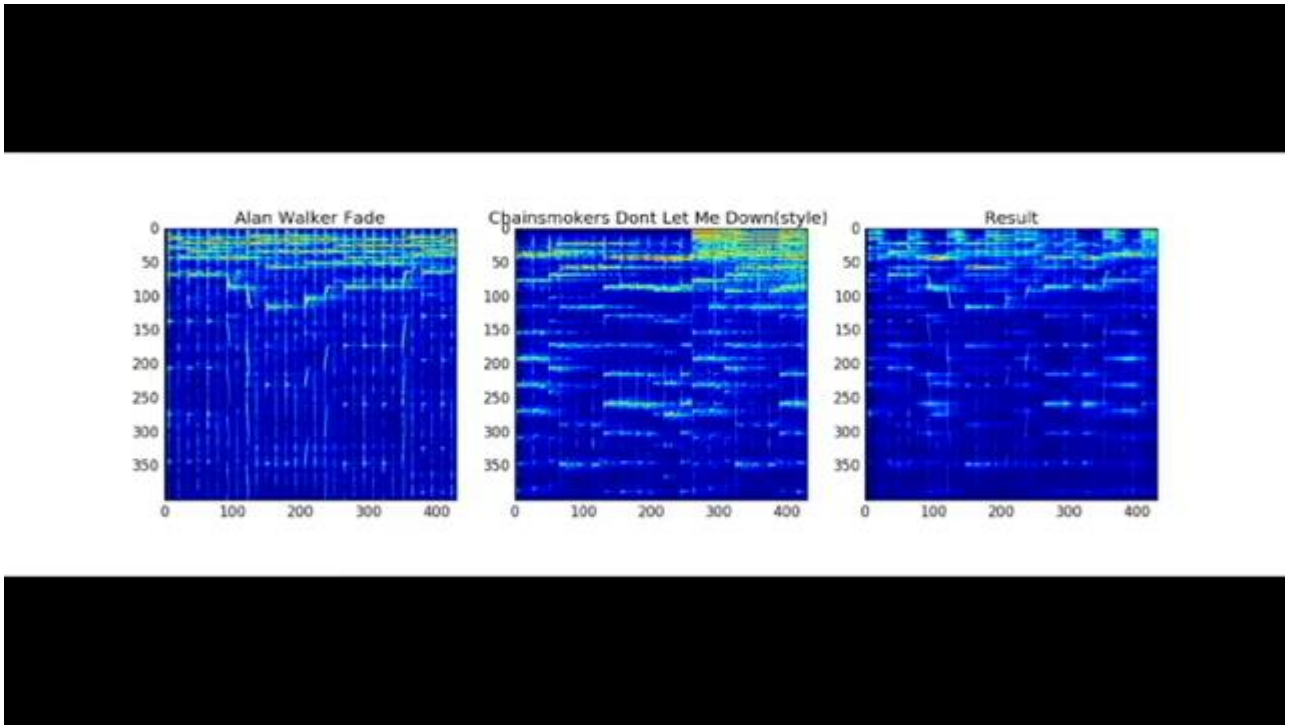
https://arxiv.org/abs/1701.04928v1


41TH ANNECY INTERNATIONAL ANIMATED FILM FESTIVAL AUDIENCE AWARD
66TH MELBOURNE INTERNATIONAL FILM FESTIVAL
61TH LONDON FILM FESTIVAL 44TH TELLURIDE FILM FESTIVAL
"전에 본 적 없는 독창적인 스타일의 영화!"
- The Telegraph -
러빙 빈센트
11월 9일, 반 고흐의 그림이 스크린에서 깨어난다!
Loving Vincent



IF
They Used Style Transfer Methods..

Neural Style Transfer to Audio



https://youtu.be/iUujo7i6P3w

Neural Style Transfer to Audio

Dmitry Ulyanov
Technical blog

Blog About

Audio texture synthesis and style transfer

by *Dmitry Ulyanov* and *Vadim Lebedev*

We present an extension of texture synthesis and style transfer method of Leon Gatys *et al.* for audio. We have developed the same code for three frameworks (well, it is cold in Moscow), choose your favorite:

Torch **TensorFlow** **Lasagne**

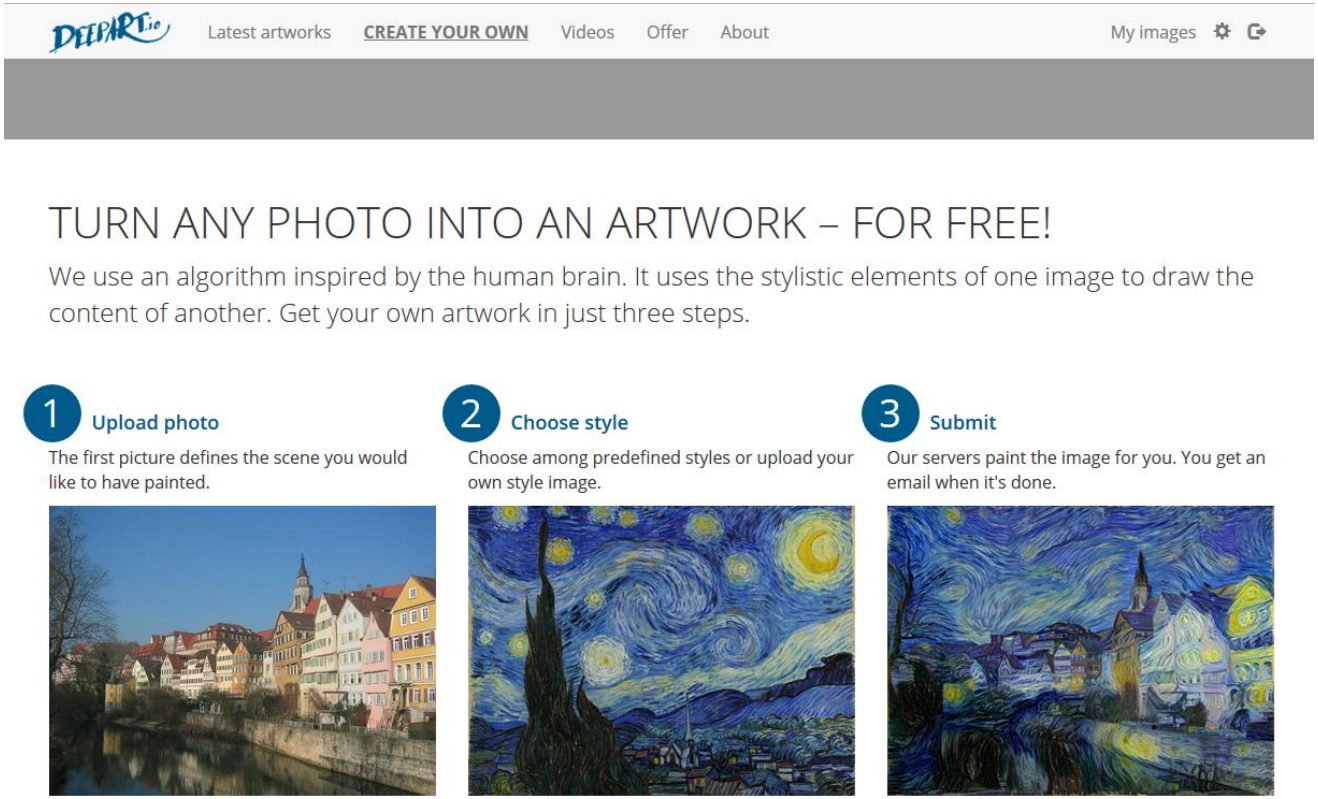
How do you apply neural-style to audio?

The modifications of image style transfer algorithm are rather straightforward.

- The raw audio is converted to a spectrogram via Short Time Fourier Transform. Spectrogram is a 2D representation of a 1D signal so it can be treated (almost) as an image. In fact is better to think of spectrogram as of `1xT` image with `F` channels.
- Next we need a network. We cannot just use VGG-19, since `3x3` convolutions are not suited for our essentially 1D problem, for which we for sure want to use 1D convolutions. Then there are two options: use a pretrained network or use completely random weights. In Torch implementation I tried to train different kind of nets, but they seem to perform similarly. As [1,2,3] Vadim also found that quality of the network is not important for texture synthesis. Nets with random weights are implemented for all three frameworks. Interestingly, the network we use has only one layer with `4096` filters.
- And finally we need to reconstruct a signal from its spectrogram. The simplest way to do the inversion is to use Griffin-Lim algorithm.

https://dmitryulyanov.github.io/audio-texture-synthesis-and-style-transfer/

DeepArt.io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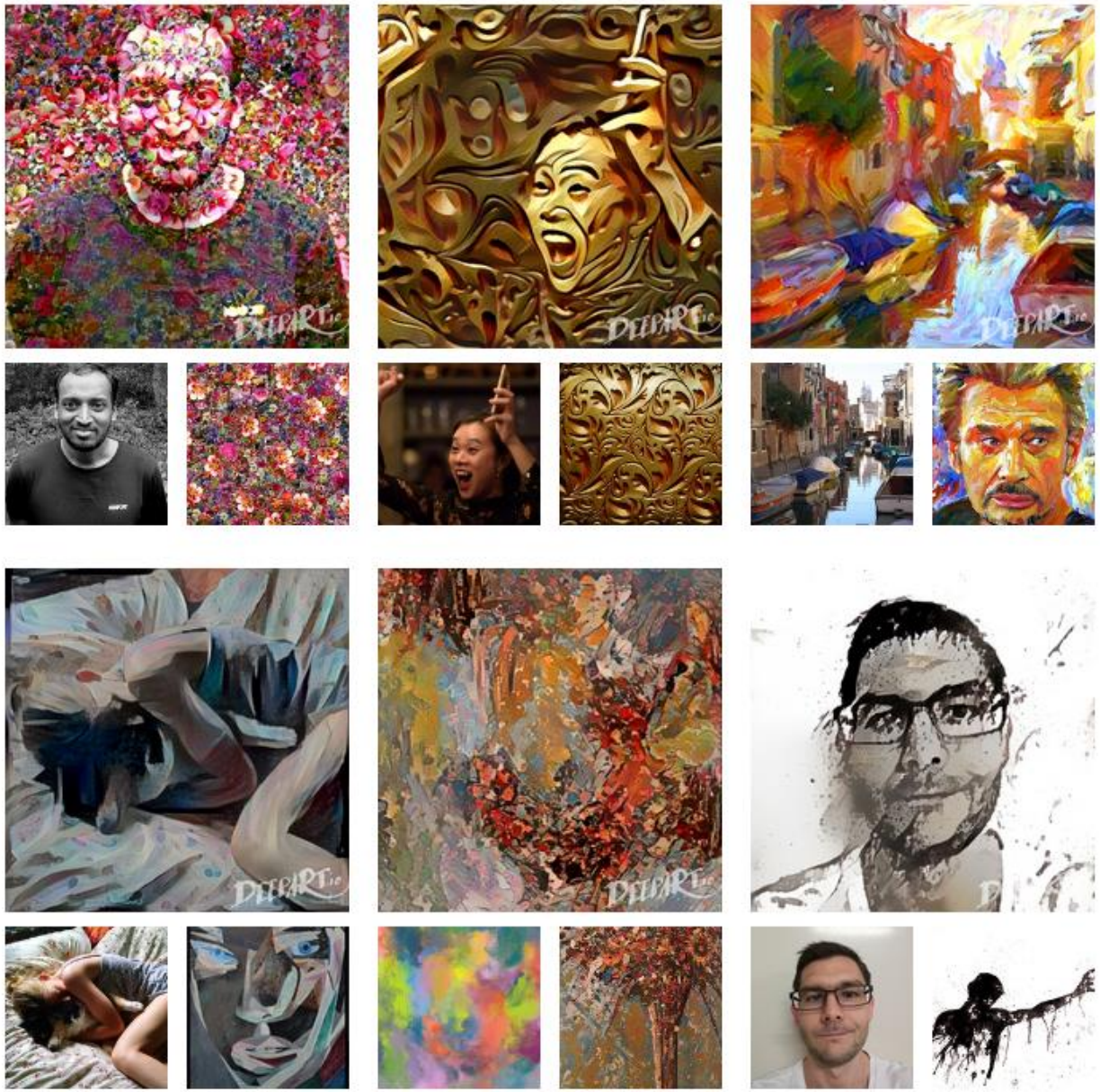

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View submissions
Rules
Sponsors

DeepArt.io

By José

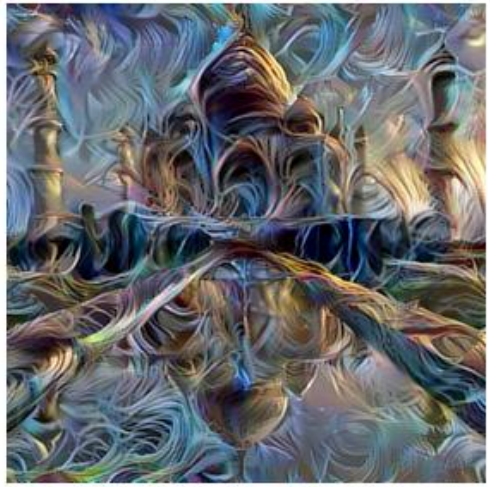
♡ 39

By Bluebird

♡ 0

By Rubeolo

♡ 10



By David Wingate

♡ 27

By Bluebird

♡ 1

By Prateep Bhattacharjee

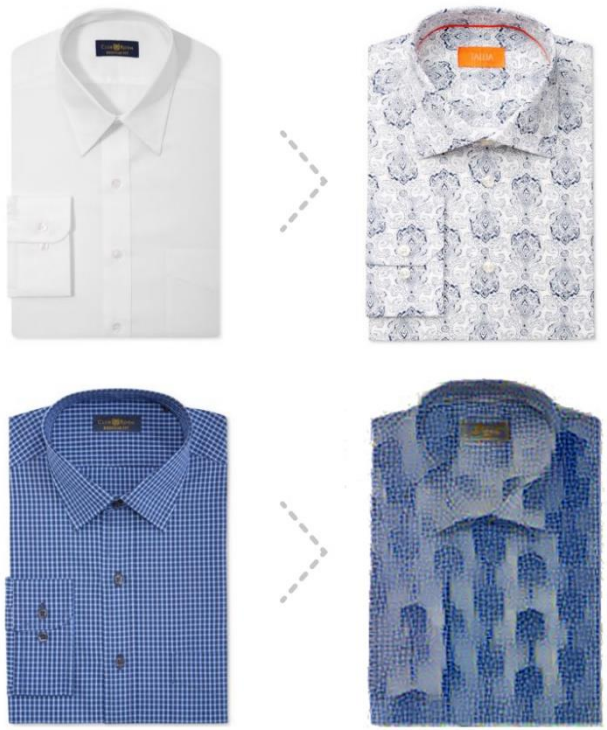
♡ 110

Fashion style transfer

Figure 1: (a) and (b) provide the shape & style respectively (c) Final Design

https://arxiv.org/abs/1707.09899v1

Fashion style transfer

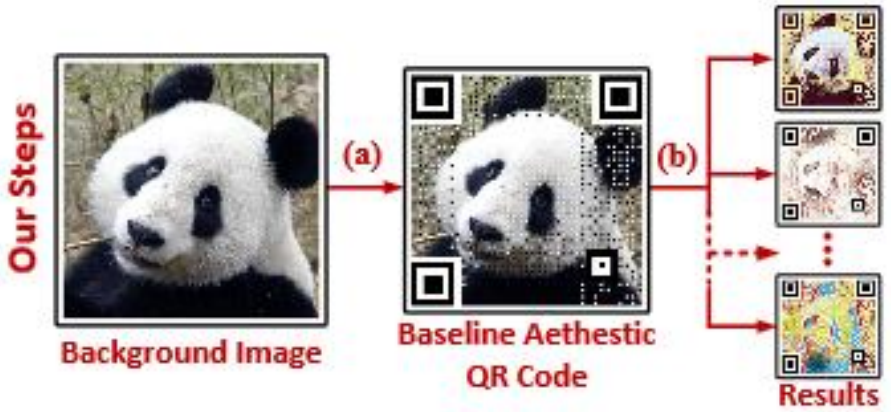


Fashion style transfer

neural style transfer
based on keras

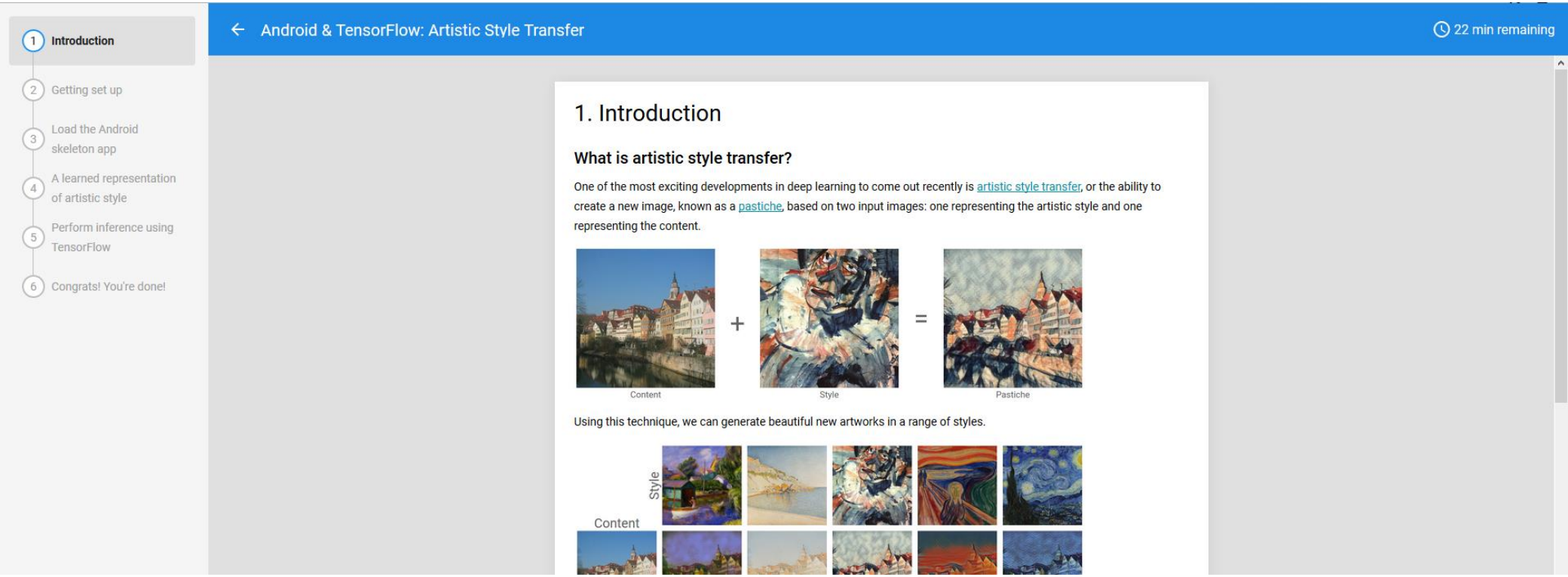
QR Code With Style Transfer

QR Code With Style Transfer



https://arxiv.org/pdf/1803.01146.pdf

Do It Yourself



https://codelabs.developers.google.com/codelabs/tensorflow-style-transfer-android/

Do It Yourself

2. Getting set up

Get the Code

There are two ways to grab the source for this codelab: either download a ZIP file containing the code, or clone it from GitHub.

ZIP Download

Click the following button to download all the code for this codelab:

DOWNLOAD SOURCE CODE

Unpack the downloaded zip file. This will unpack a root folder (`tensorflow-style-transfer-android-codelab-start`), which contains the base app we'll work on in this codelab, including all of the app resources.

Check out from GitHub

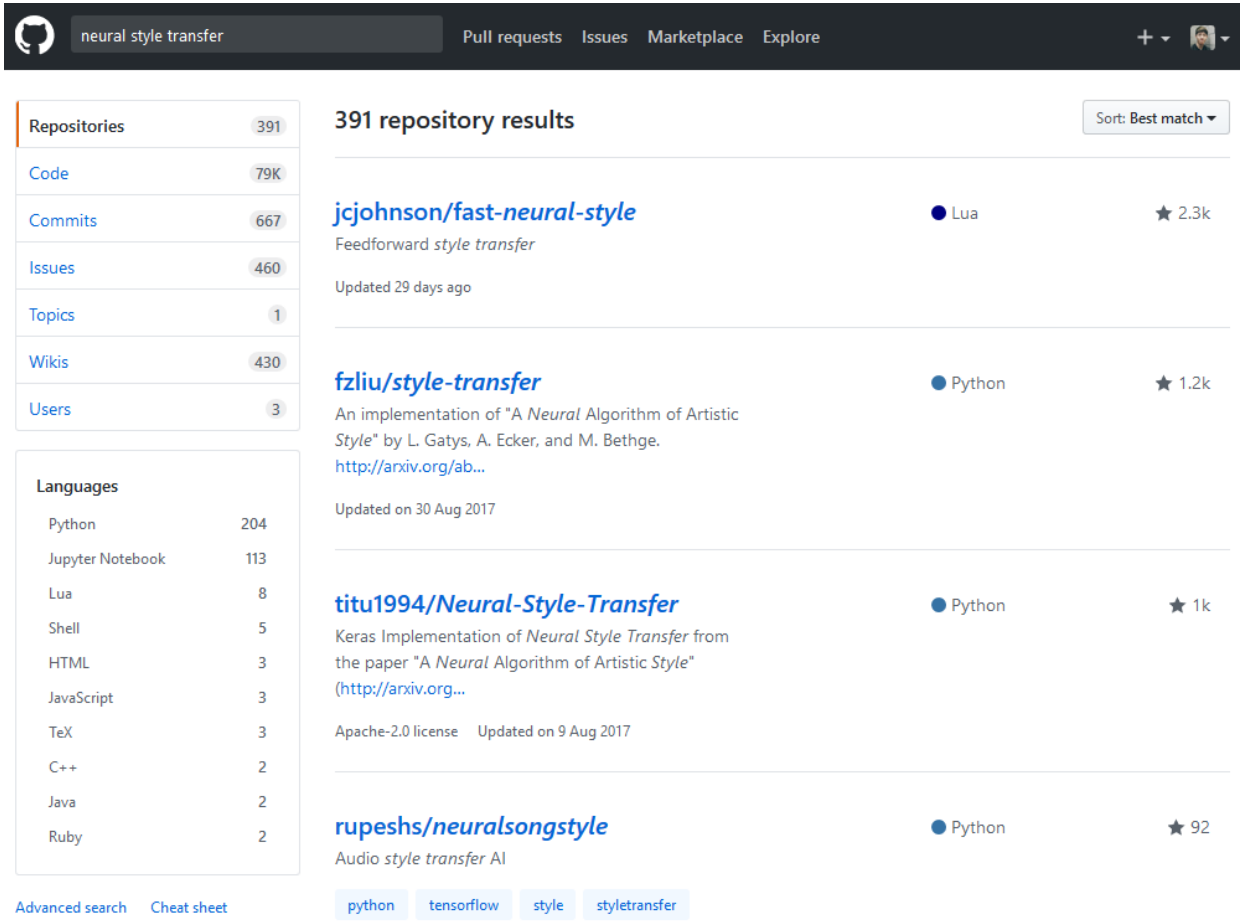
Check the code out from GitHub:

```
git clone https://github.com/googlecodelabs/tensorflow-style-transfer-android
```

This will create a directory containing everything you need. If you change into it you can use `git checkout codelab-start` and `git checkout codelab-finish` to switch between the start & end of the lab, respectively.

https://codelabs.developers.google.com/codelabs/tensorflow-style-transfer-android/

Do It Yourself



예술과 딥러닝 그 사이

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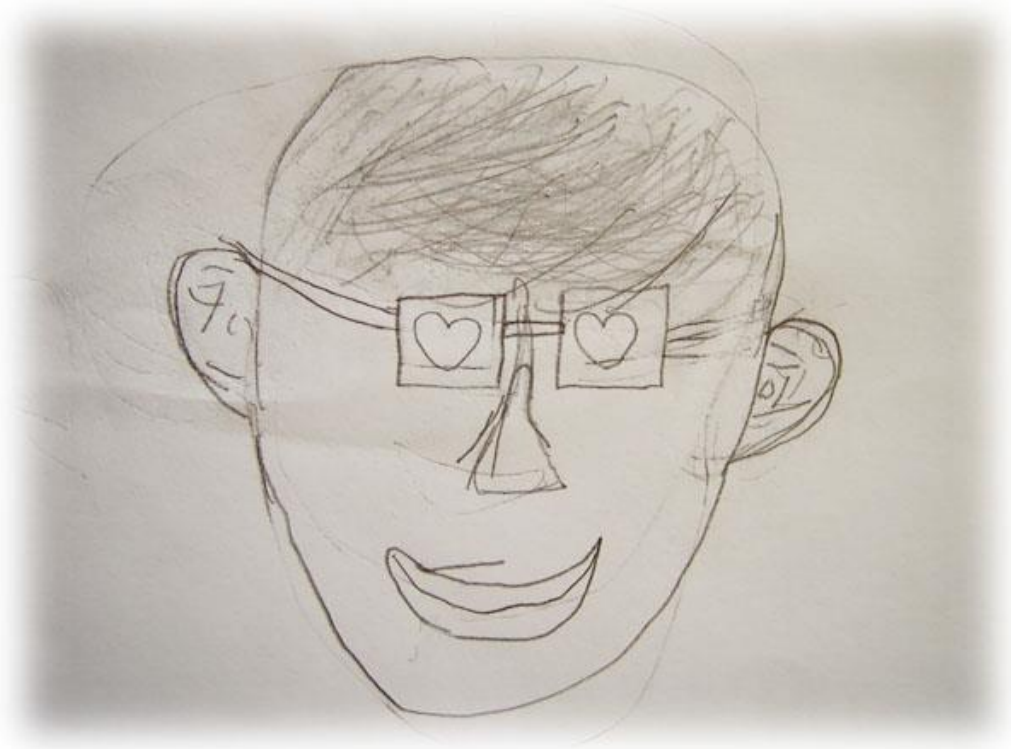

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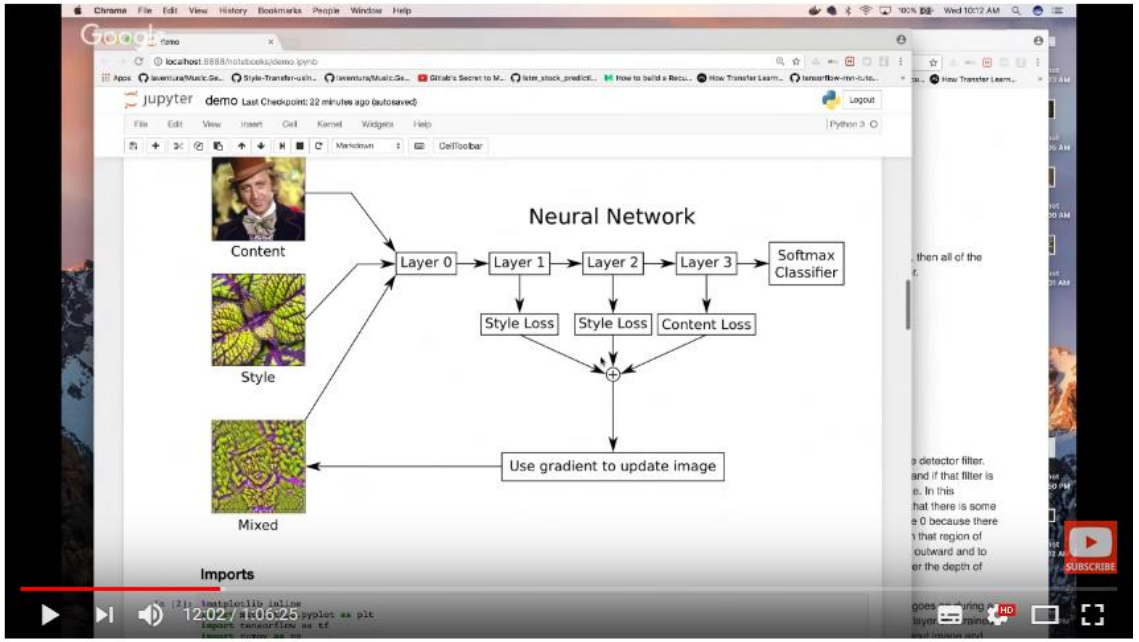

How to Do Style Transfer with Tensorflow (LIVE)

조회수 18,509회

239 10 공유

Siraj Raval

실시간 스트리밍 시작일: 2017. 3. 8.

구독중 31만

https://youtu.be/YoBEGQD3LCc

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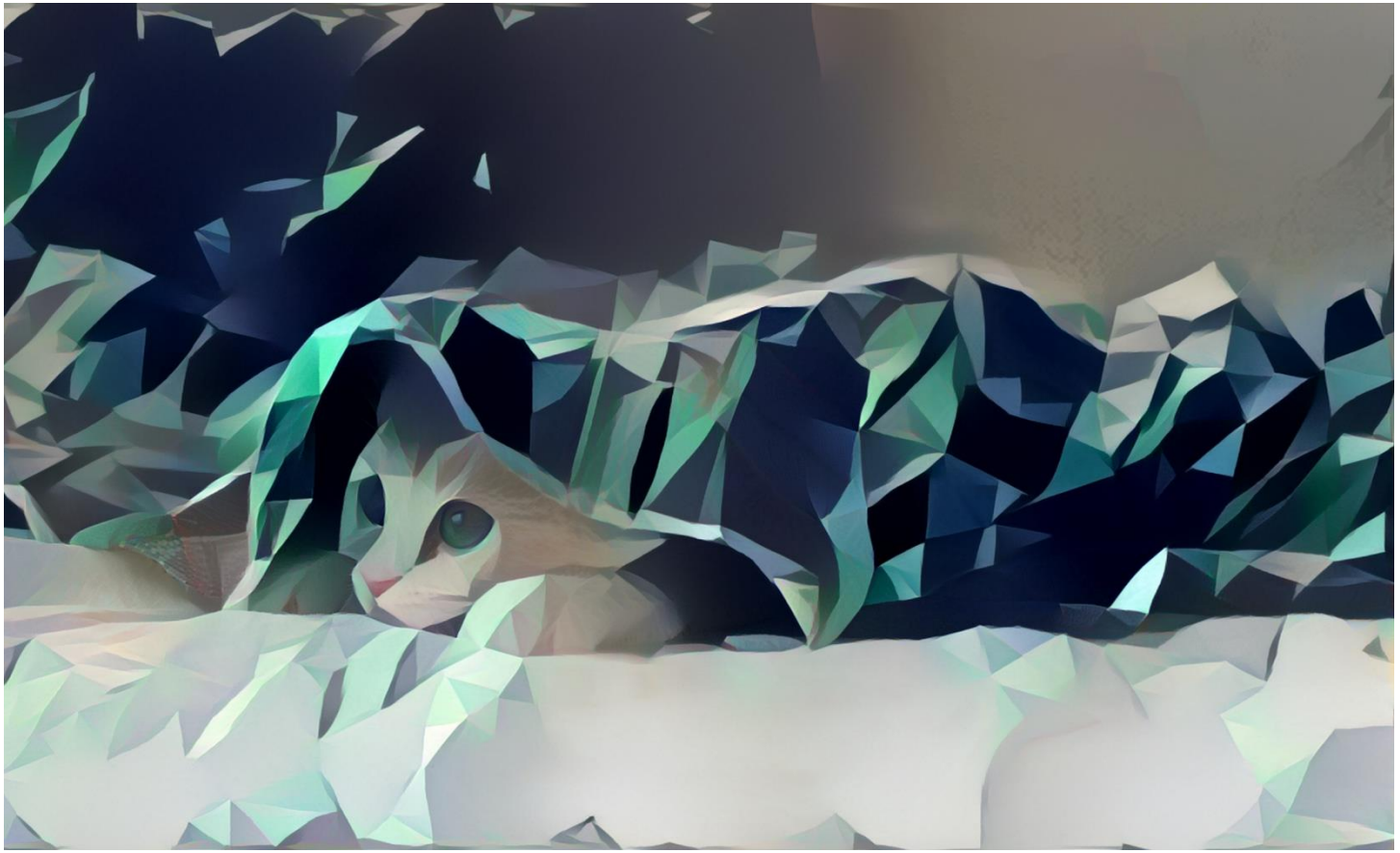

Thanks You!