Inner-Class and Inter-Class Style Transfer using CycleGAN

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- Method Overview
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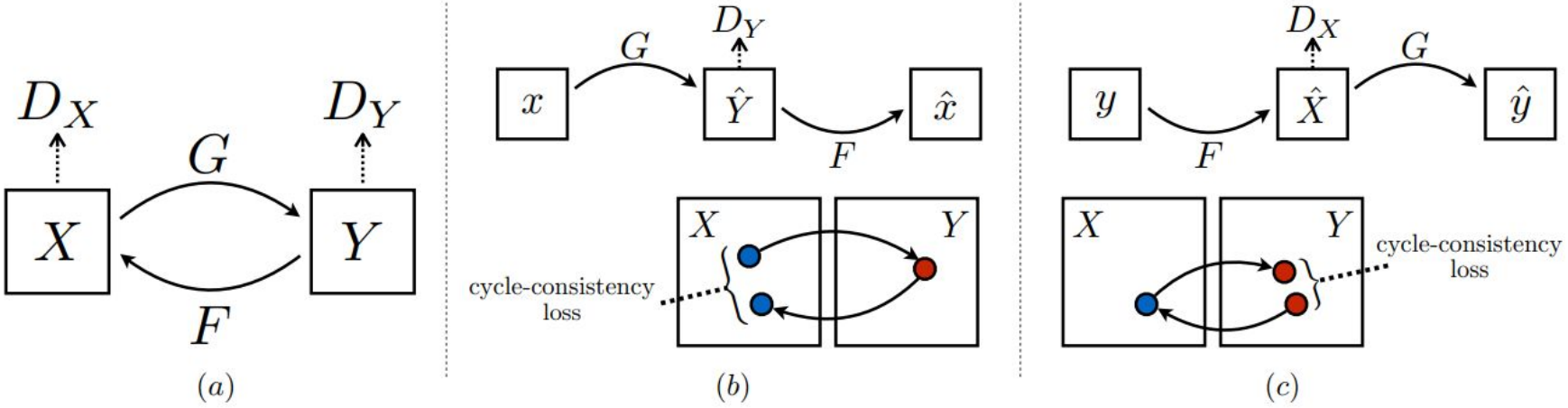
Problem Description and Motivation

- Image-to-image translation
  - Learn the mapping from input image to output image
  - Applications
    - Style transfer, object transfiguration, and photo enhancement
- Lack of paired training data
  - Cycle-Consistent Adversarial Networks
    - Learns the mapping under the constraint of the cycle consistency

Method Overview

- CycleGAN
  - Learns the mapping (e.g. G : X → Y)
  - Under the constraint of inverse mapping (e.g. F(G(X)) ≈ X)



Inner-Class and Inter-Class Style Transfer using CycleGAN

Method Overview

- Generator
  - 9-block Residual network
- Discriminator
  - 40×40 PatchGAN
    - Classify whether 40×40 overlapping image patches are real or fake

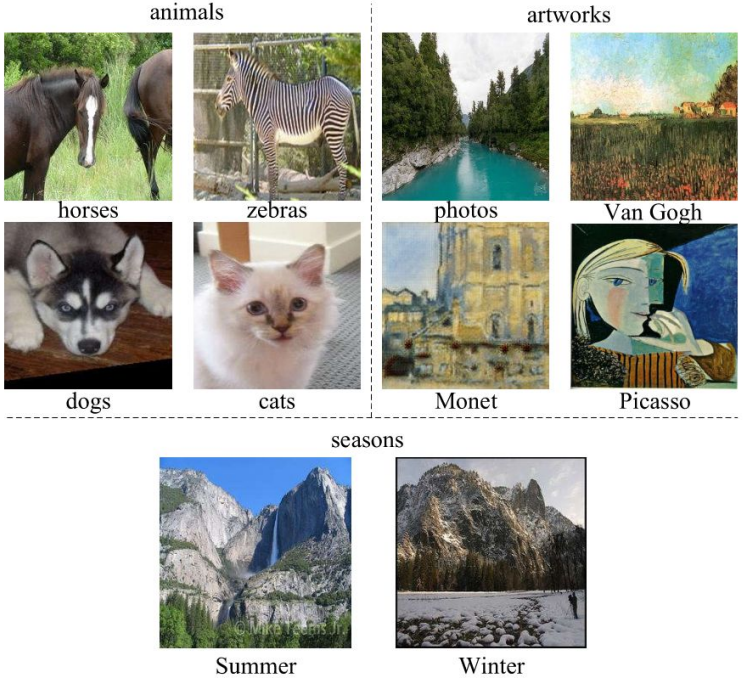
layer name	layer setting
conv 0	$[4 \times 4, 64]$, pad=1, stride=2 Leaky ReLU
conv 1	$[4 \times 4, 128]$, pad=1, stride=2 Instance Norm + Leaky ReLU
conv 2	$[4 \times 4, 256]$, pad=1, stride=2 Instance Norm + ReLU
conv 3	$[4 \times 4, 512]$, pad=1, stride=1 Instance Norm + ReLU
conv final	$[4 \times 4, 1]$, pad=1, stride=1

Table 2: Detailed architecture of discriminator

layer name	layer setting
conv0_1	$[7 \times 7, 64]$, pad=1, stride=1 Instance Norm + ReLU
conv0_2	$[3 \times 3, 128]$, pad=1, stride=1 Instance Norm + ReLU
conv0_3	$[3 \times 3, 128]$, pad=1, stride=2 Instance Norm + ReLU
Residual Block 1	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 2	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 3	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 4	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 5	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 6	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 7	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 8	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
Residual Block 9	$[3 \times 3, 256]$, pad=1, stride=1 Instance Norm + ReLU $\times$ 2
deconv 1	$[3 \times 3, 128]$, stride=2 Instance Norm + ReLU
deconv 2	$[3 \times 3, 64]$, stride=2 Instance Norm + ReLU
conv final	$[7 \times 7, 3]$, pad=1, stride=1 Tanh

Table 1: Detailed architecture of generator: 9-block

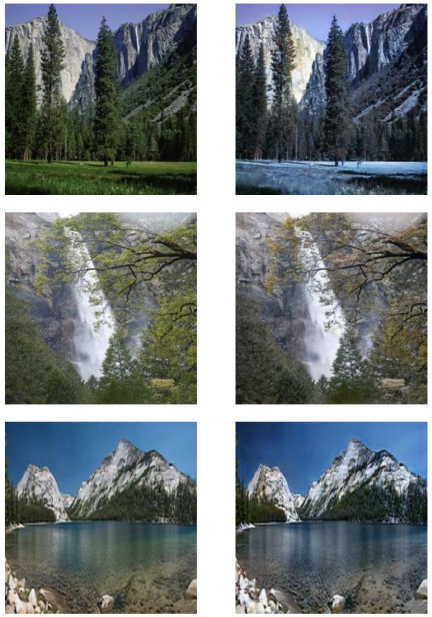
Inner-class and inter-class



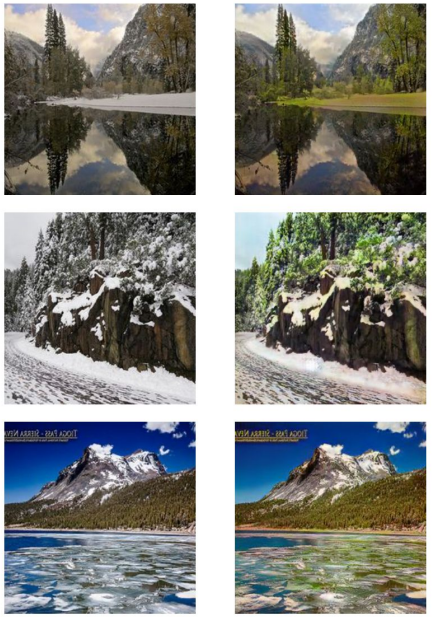
Inner-Class and Inter-Class Style Transfer using CycleGAN

Results (Inner-Class)

summer → winter



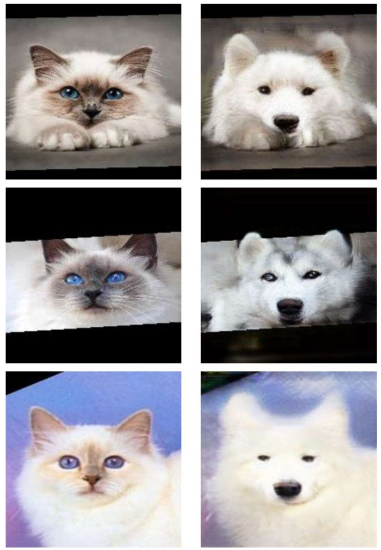
winter → summer



Inner-Class and Inter-Class Style Transfer using CycleGAN

Results (Inner-Class)

cat → dog



dog → cat

Horse → Zebra

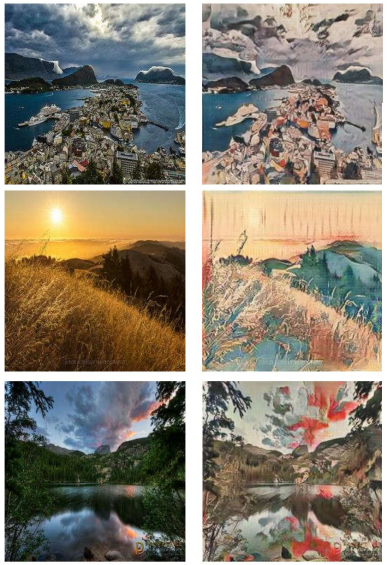
Zebra → Horse

Inner-Class and Inter-Class Style Transfer using CycleGAN

Results (Inner-Class)

Ukiyoe → photo

photo → Ukiyoe



Picasso → photo

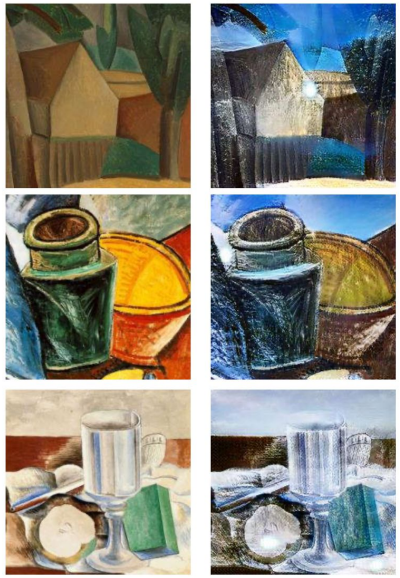
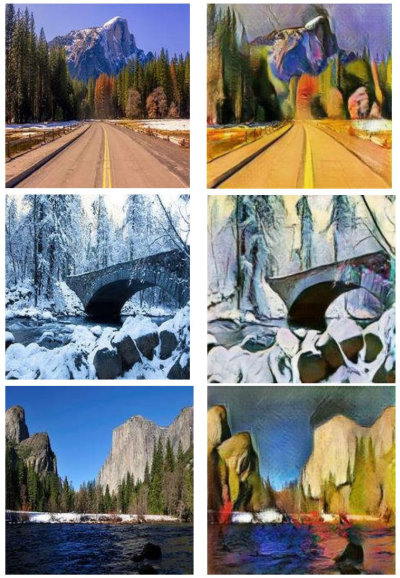


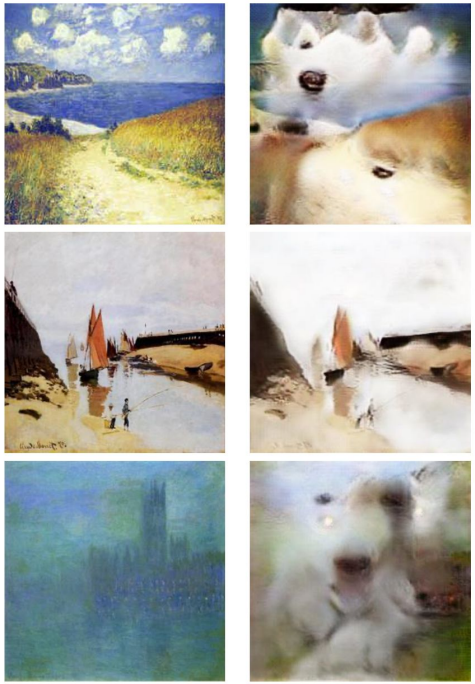
photo → Picasso



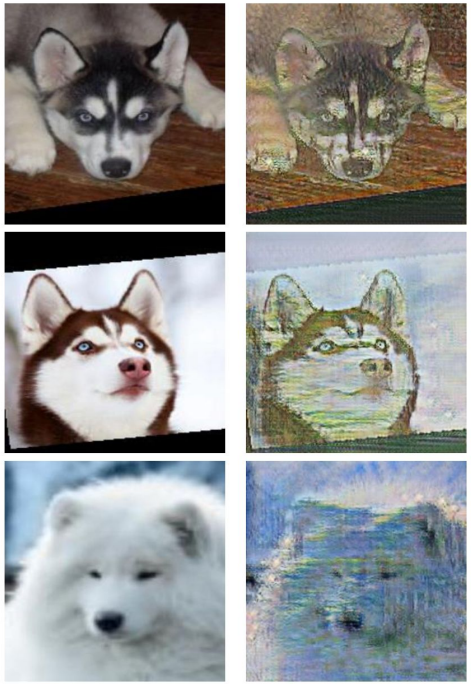
Inner-Class and Inter-Class Style Transfer using CycleGAN

More interesting results (inter-class)…

Monet → dog



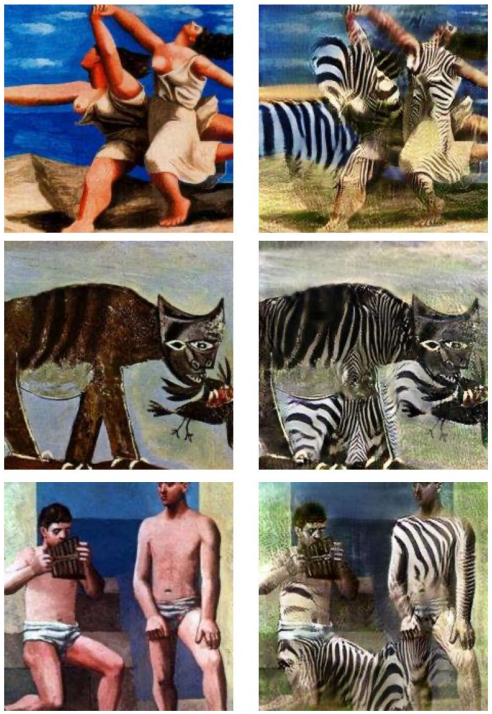
dog → Monet



Inner-Class and Inter-Class Style Transfer using CycleGAN

More interesting results…

Picasso → zebra



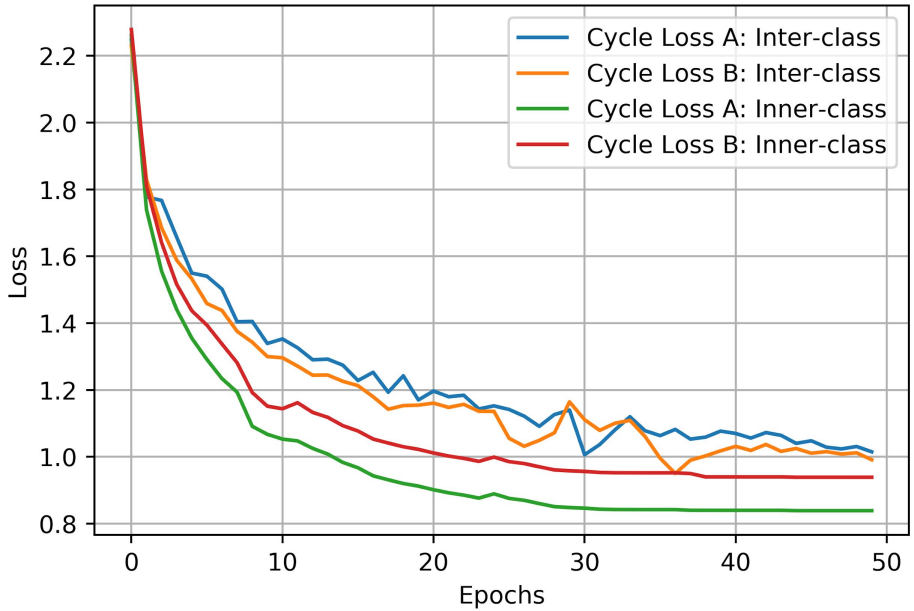
zebra → Picasso

Inner-Class and Inter-Class Style Transfer using CycleGAN

Conclusion and Discussion

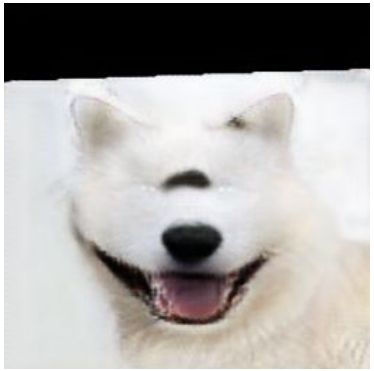
- Inter-class style transfer is generally harder than inner-class style transfer
  - Domain gap is bigger for inter-class style transfer
- Style transfer on animals is generally harder than on landscapes
  - Animals usually have more attributes than the pure landscapes
- Artworks to photo is generally harder than photo to artworks
  - Artworks usually contain objects that are highly different from real objects

Discussion: Why this happened?



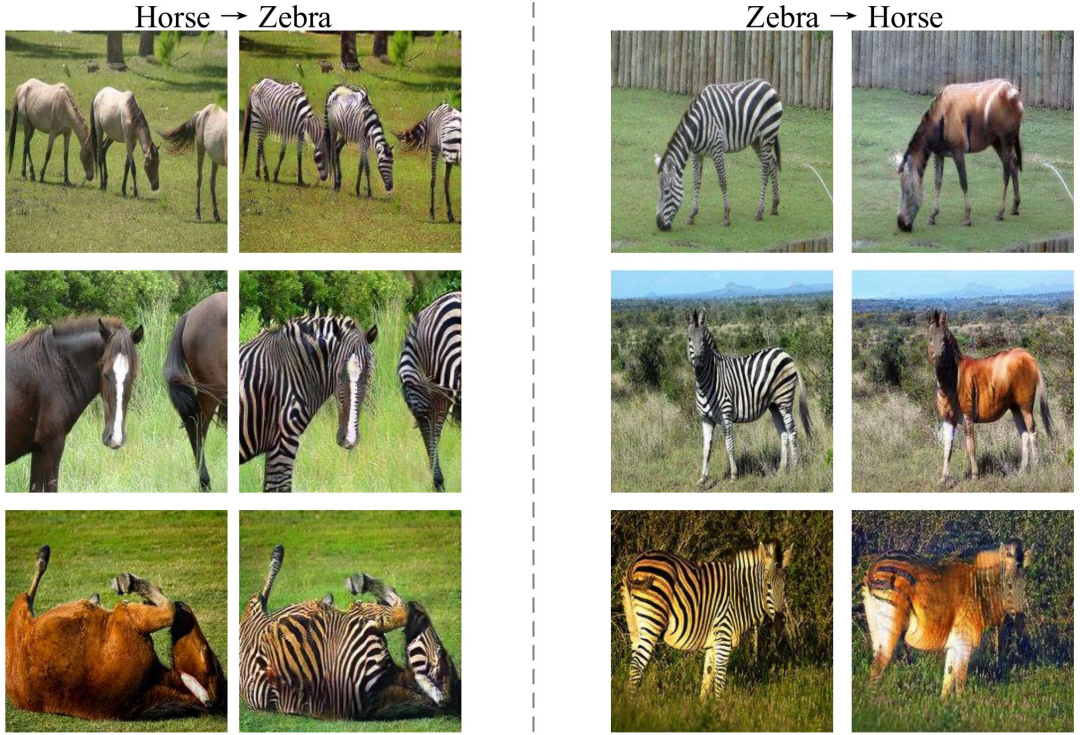
VanGogh2photo (Inner-class) vs VanGogh2zebra (Inter-class)

Some failures




Thanks for watching!
Questions...

Results (Inner-Class)



Inner-Class and Inter-Class Style Transfer using CycleGAN

Results (Inner-Class)

Picasso → photo

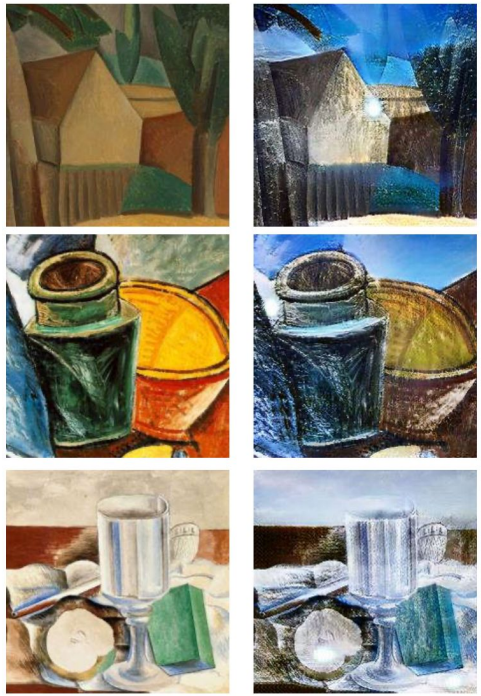
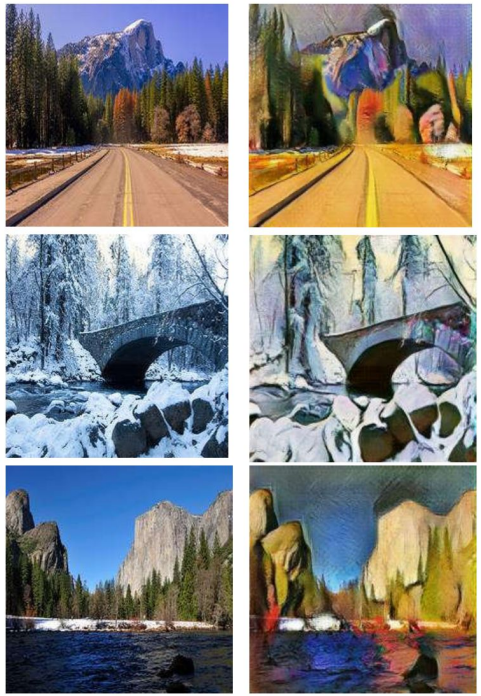


photo → Picasso

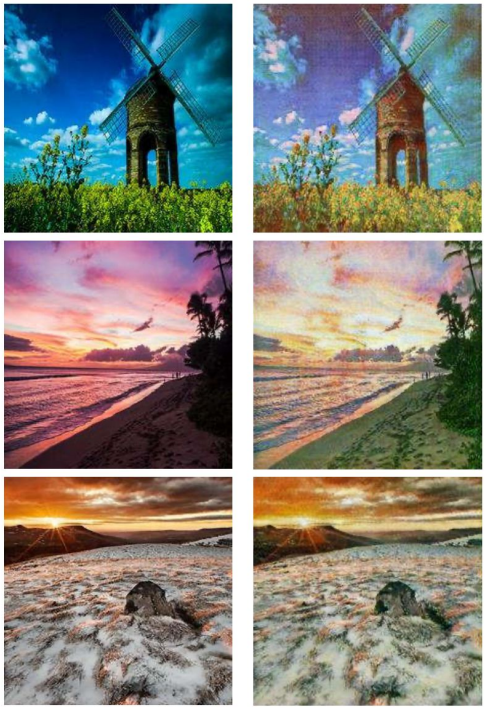


Inner-Class and Inter-Class Style Transfer using CycleGAN

Results (Inner-Class)

Monet → photo

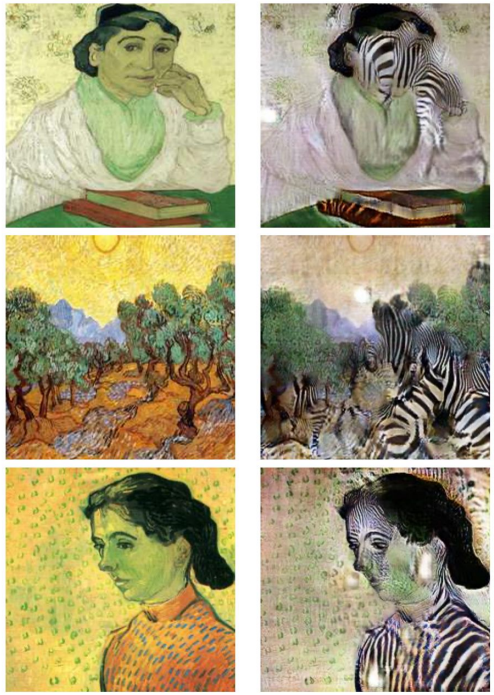
photo → Monet



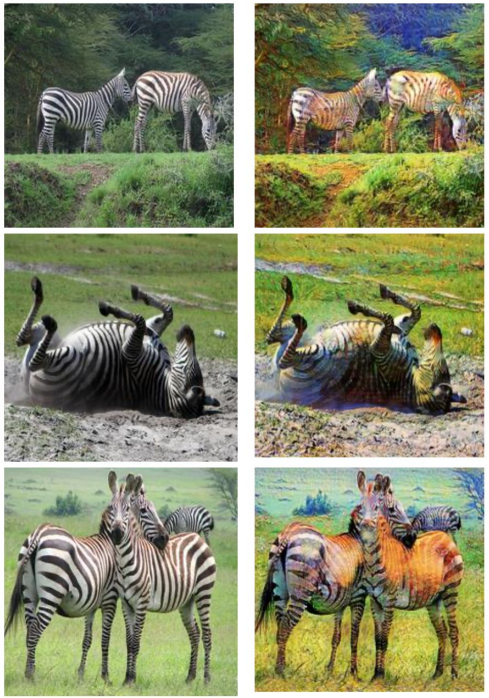
Inner-Class and Inter-Class Style Transfer using CycleGAN

More interesting results…

Van Gogh → zebra



zebra → Van Gogh



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