

[Deep Learning Seminar]  
Season 3 : Deep Learning Paper Review

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

By Jun-Yan Zhu et al.

Hanyang University  
Artificial Intelligence Lab.  
Gunhee Cho

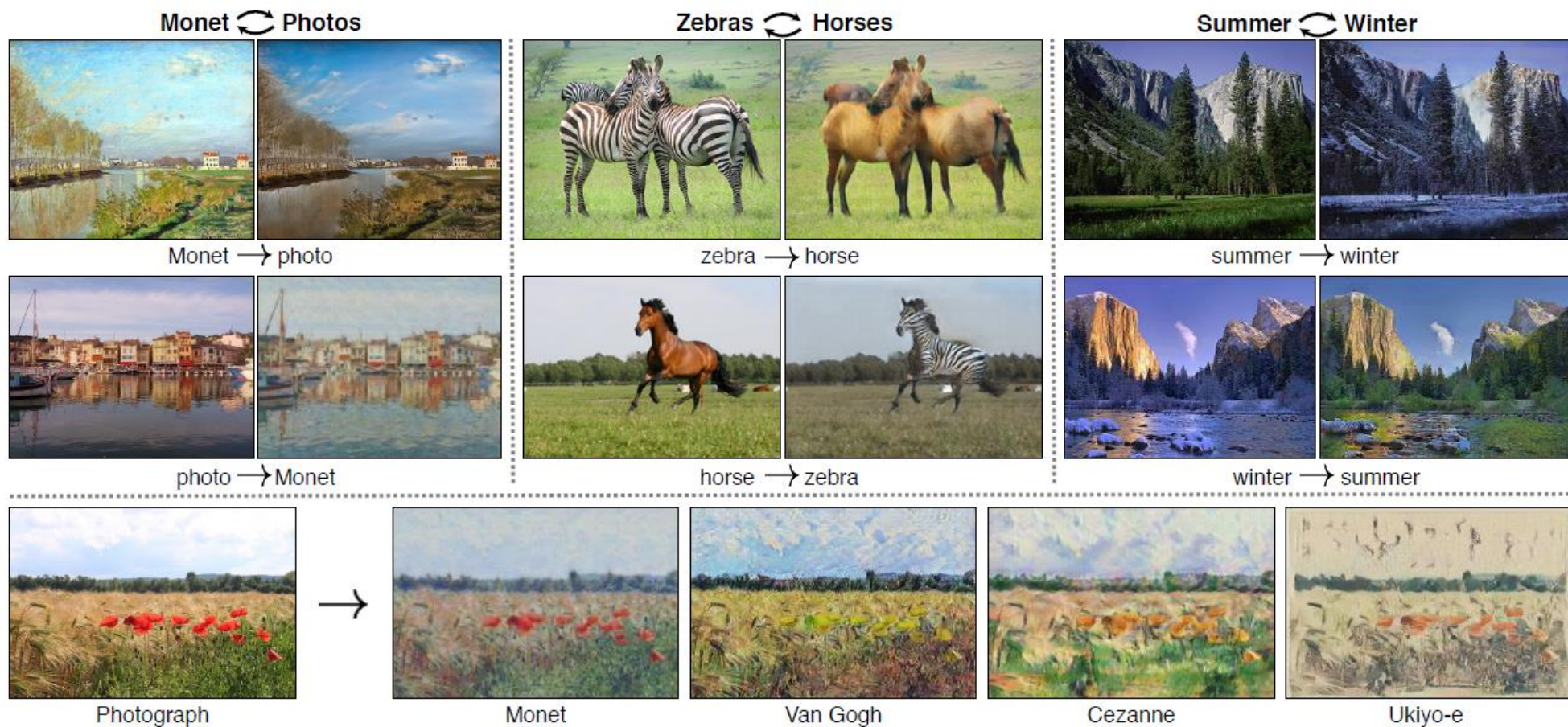
DiscoGAN 발표를 준비하던 어느 날..



“CycleGAN”

띠용 ㅈㄴ 신기하네..

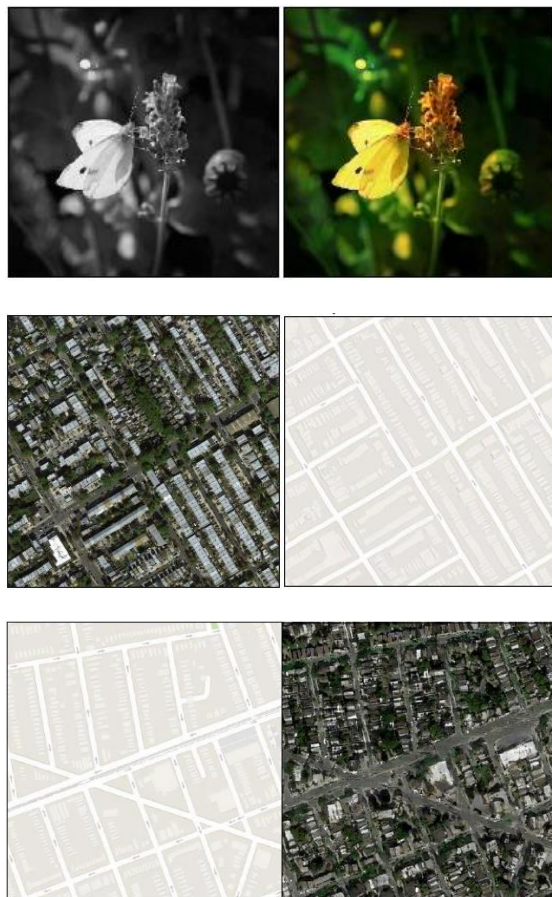
# 이걸로 뭘 할 수 있을까?





# pix2pix랑 뭐가 달라?

pix2pix



CycleGAN



# 멍청한 G와 D

Loss :  $L_{GAN}(G(x), y)$

G

그림을  
"사진"처럼만  
만들면 되는 거지?

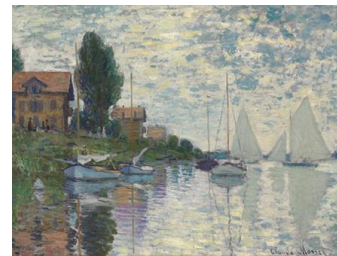
○○ "사진"은  
맞네

D

CycleGAN



?



?

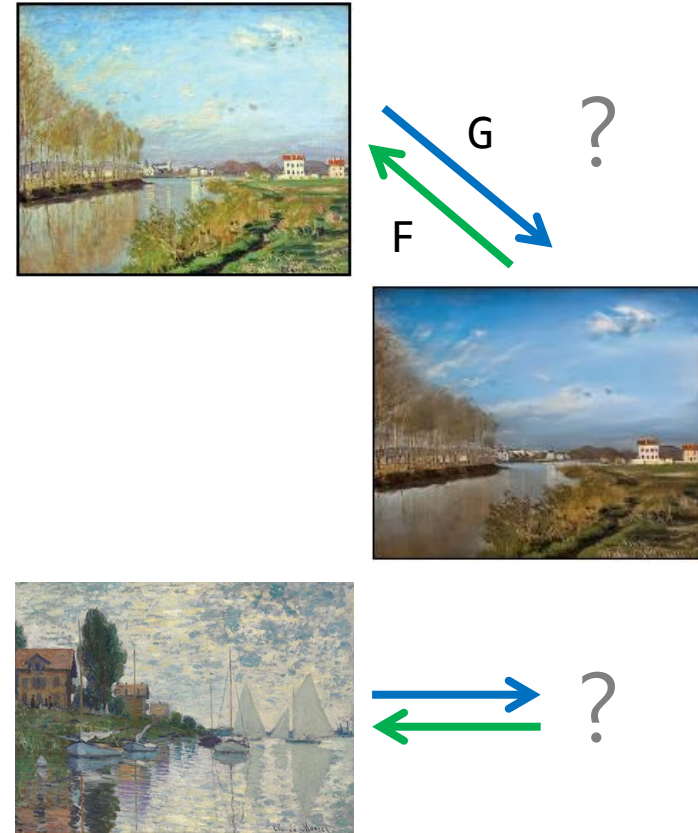
# 요렇게 해결!!

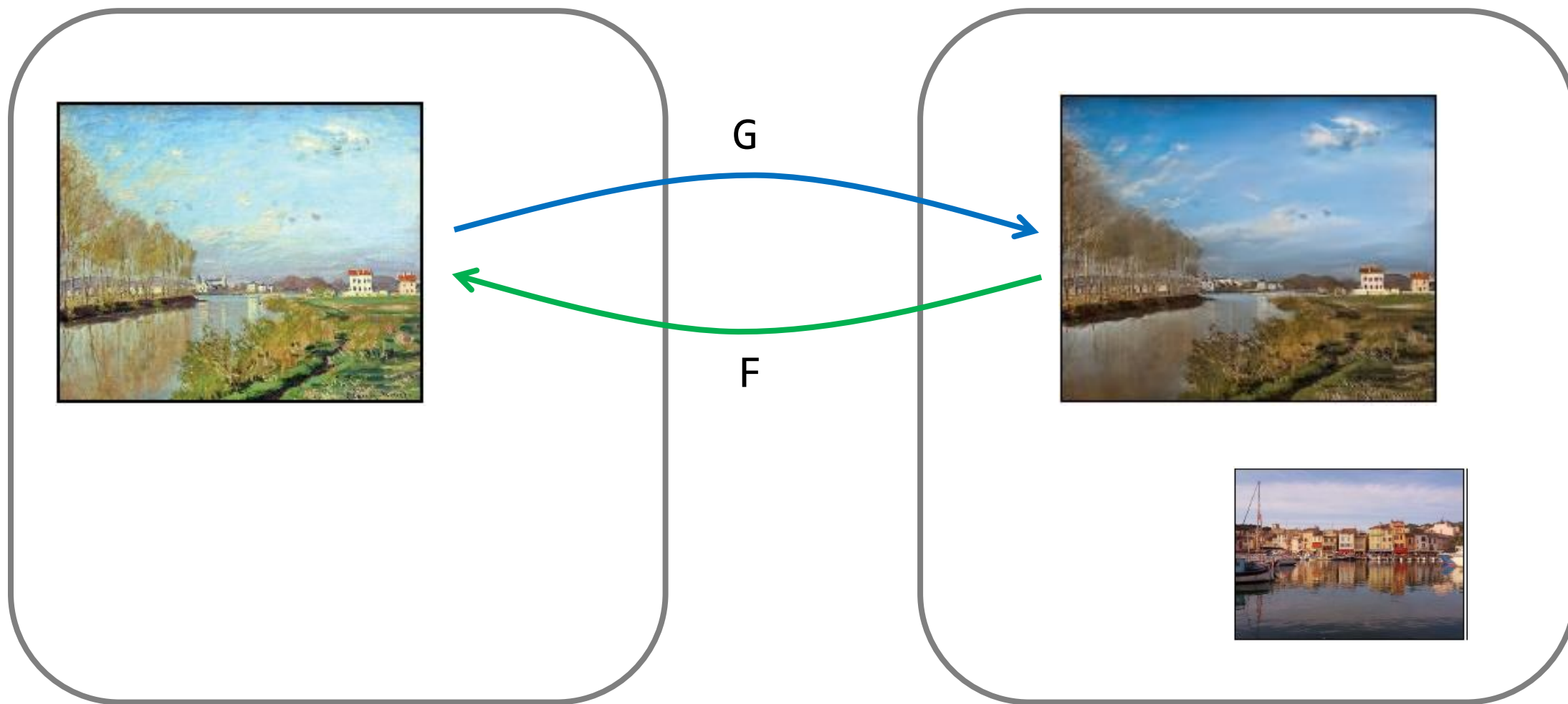
$$\text{Loss} : L_{GAN}(G(x), y) + \|F(G(x)) - x\|_1$$

F

내가 복원 해줄게!

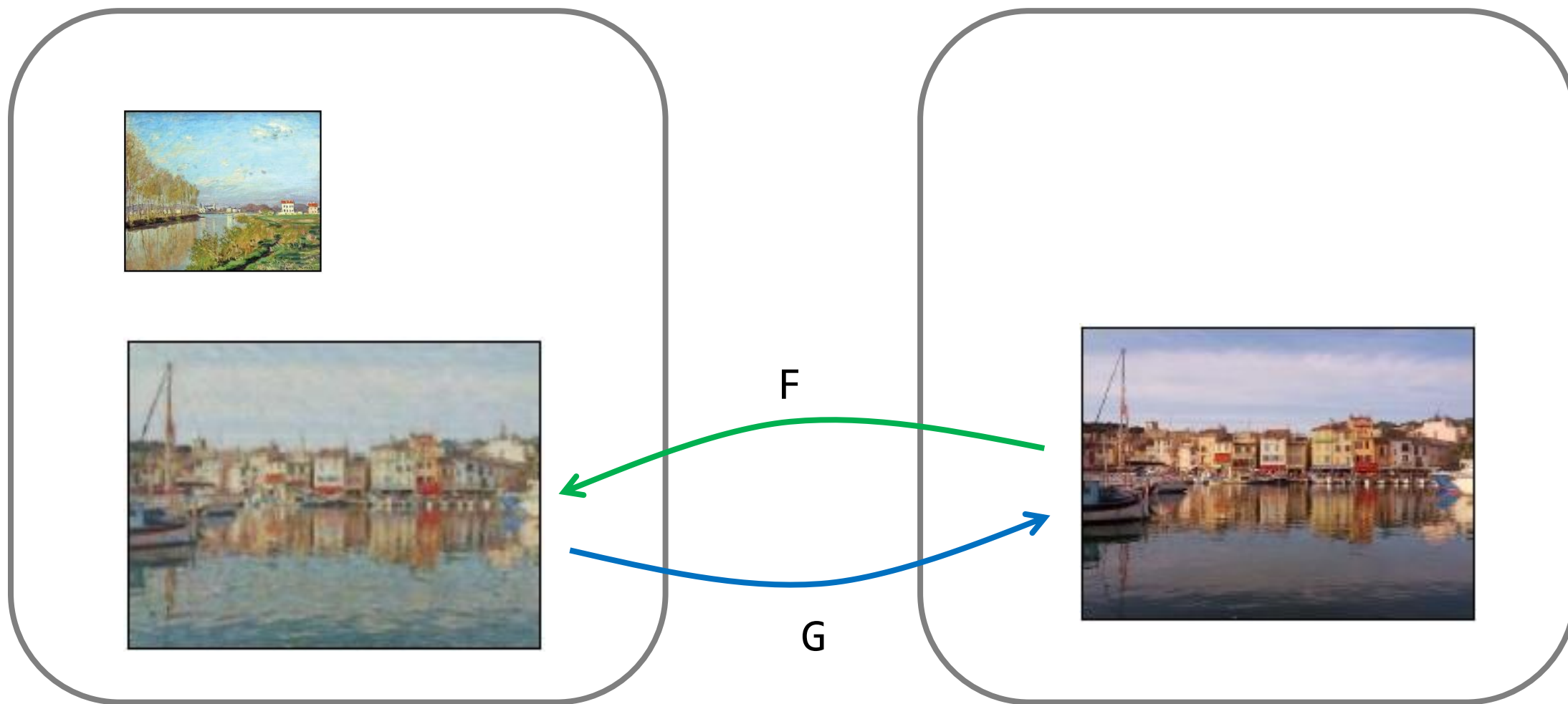
CycleGAN



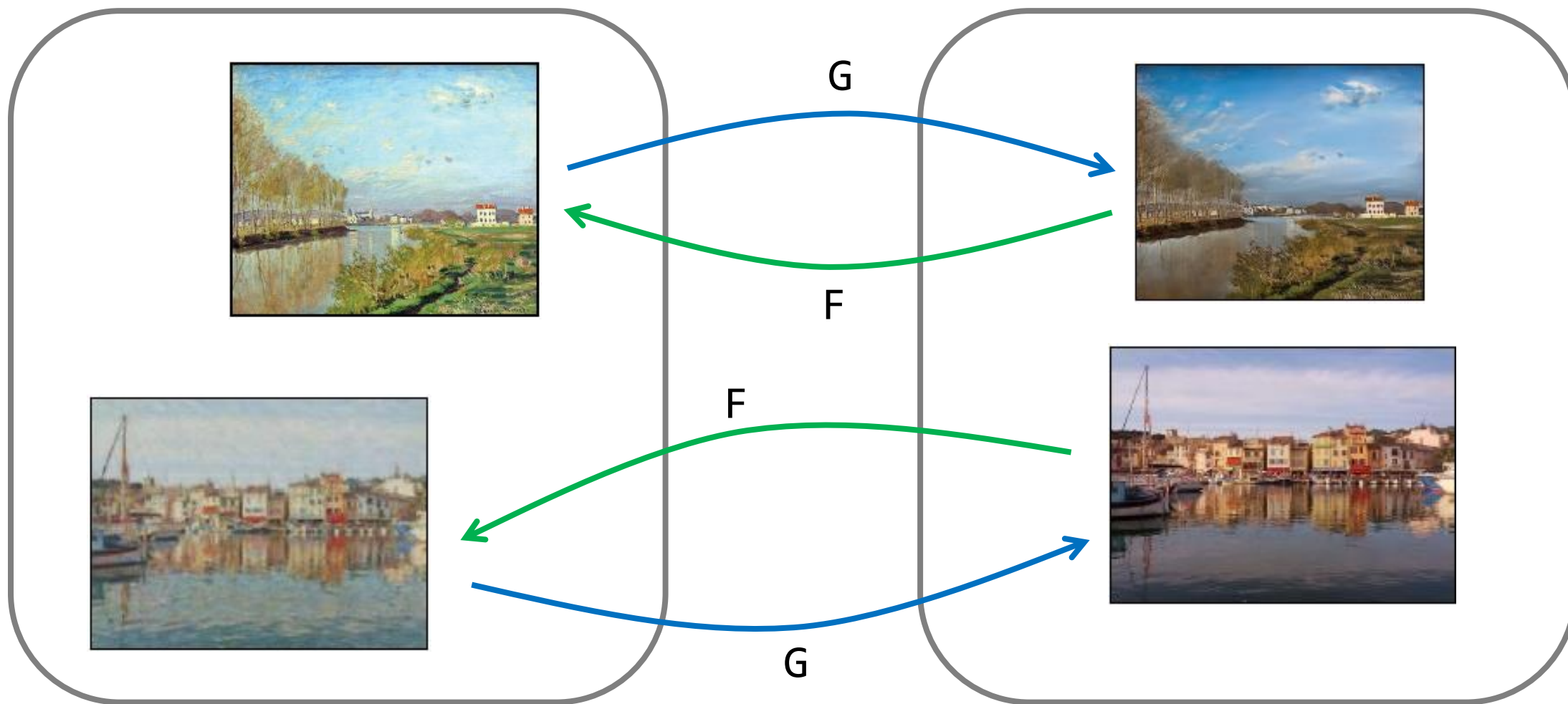


$$L_{GAN}(G(x), y) + \|F(G(x)) - x\|_1$$



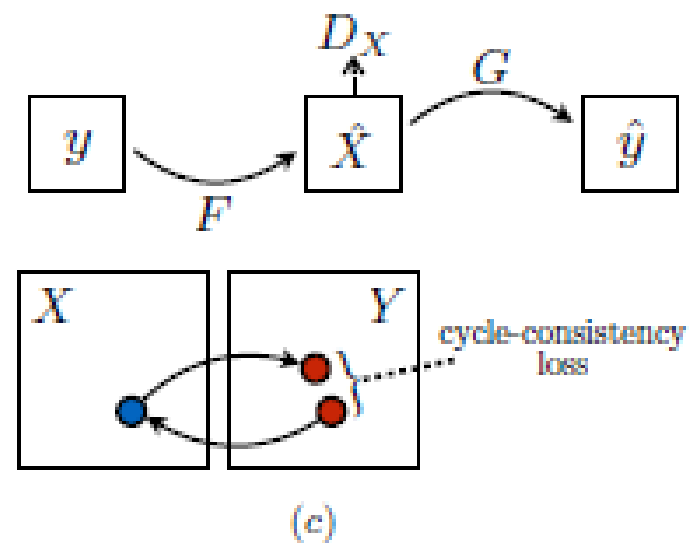
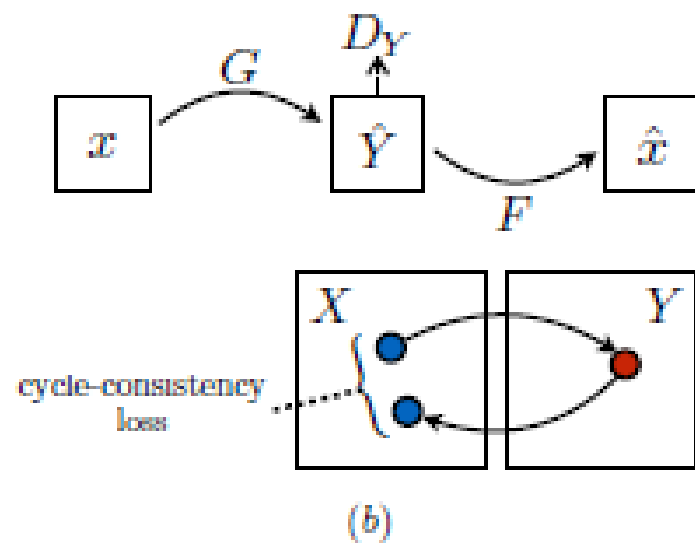
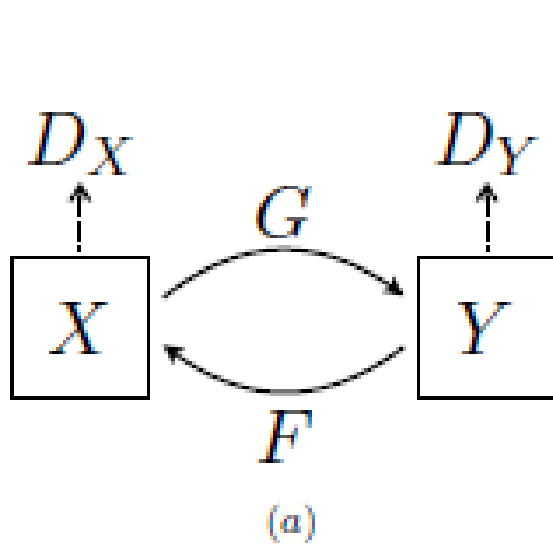


$$L_{GAN}(F(y), x) + \|G(F(y)) - y\|_1$$



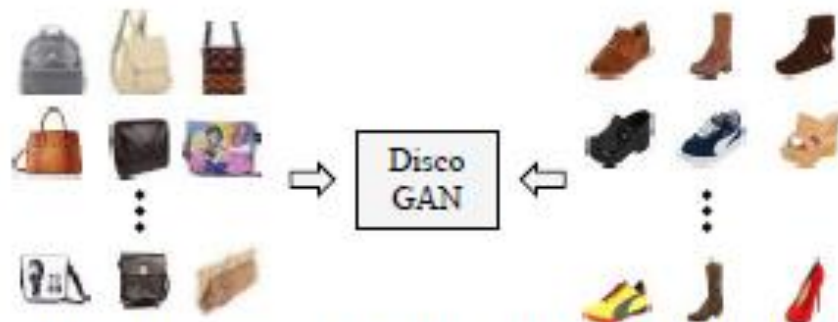
$$L_{GAN}(G(x), y) + \|F(G(x)) - x\|_1 + L_{GAN}(F(y), x) + \|G(F(y)) - y\|_1$$

짜잔~



아니....

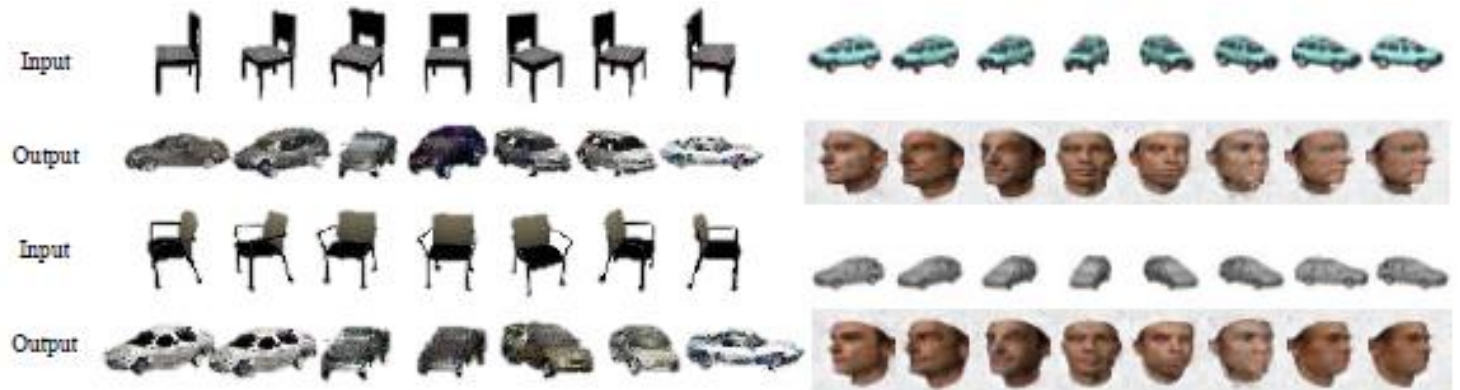
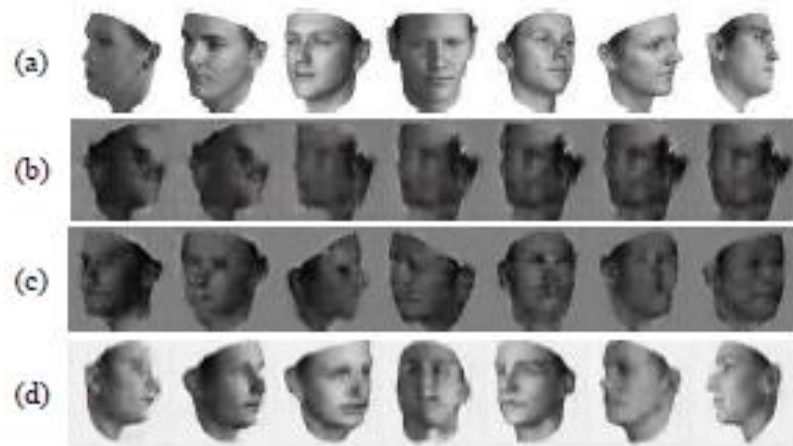
# 근데 이거 DiscoGAN이랑 똑같은 거 아님?



(a) Learning cross-domain relations without any extra label



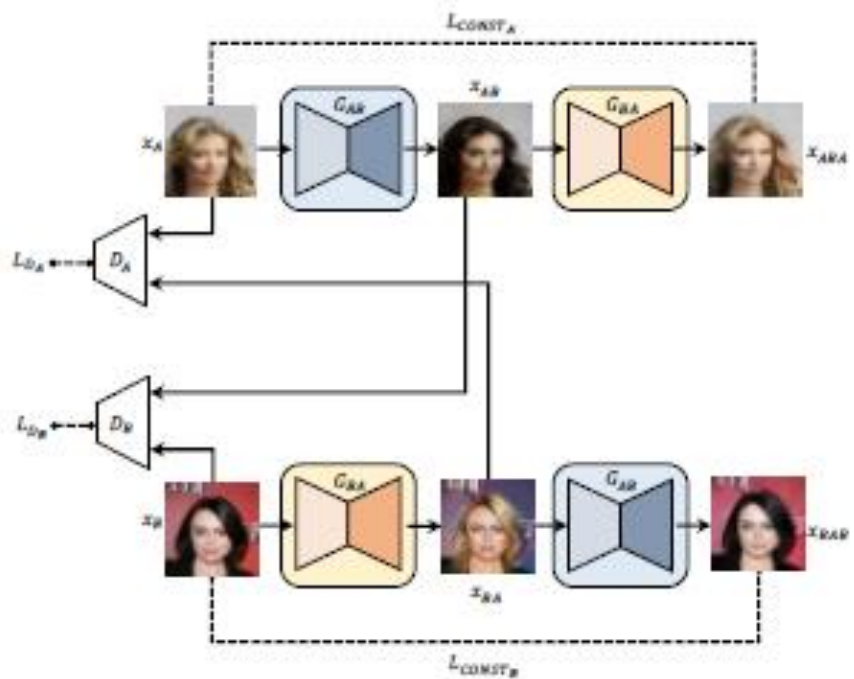
(b) Handbag images (input) & Generated shoe images (output)



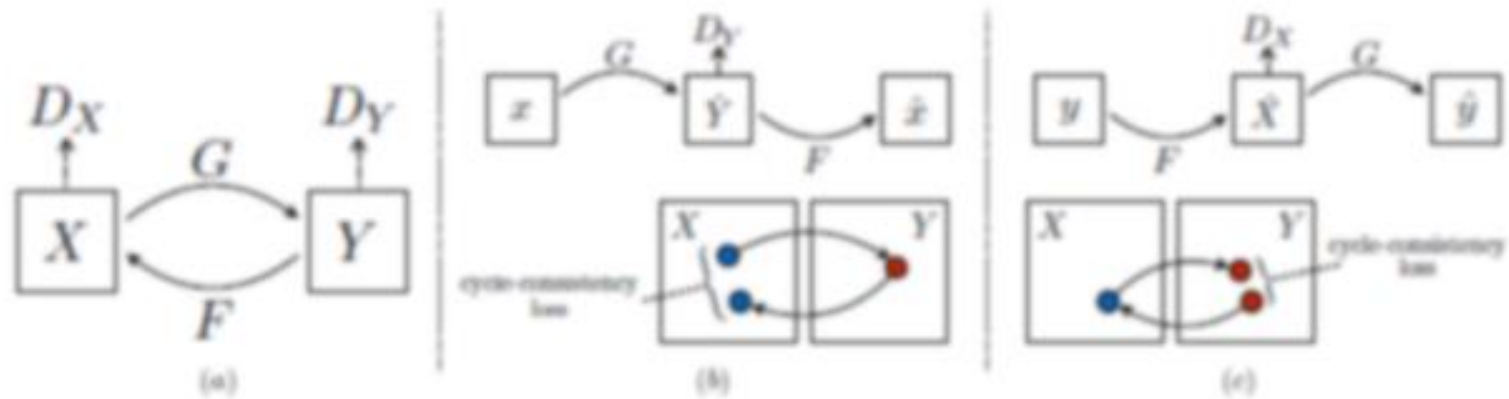
(a) Chair to Car

(b) Car to Face

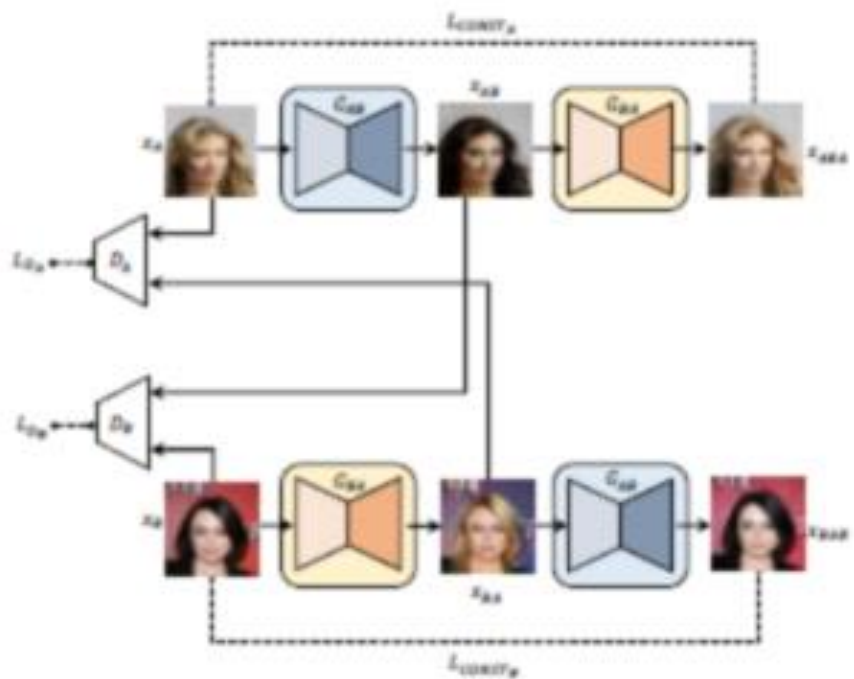




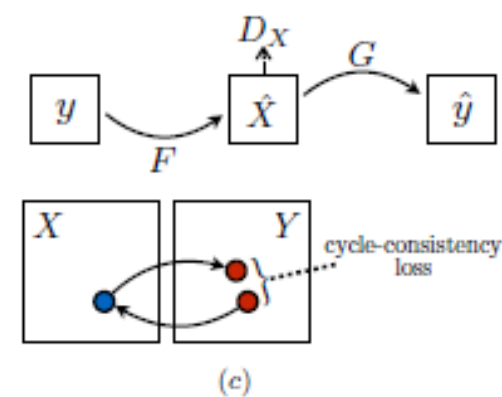
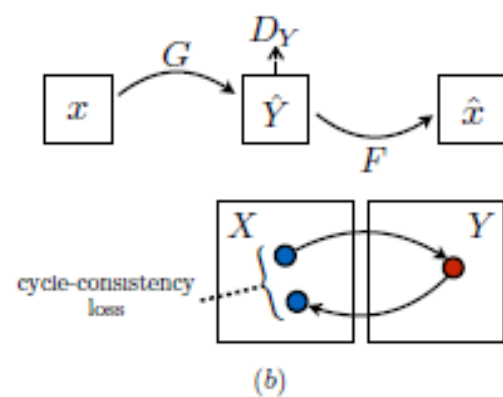
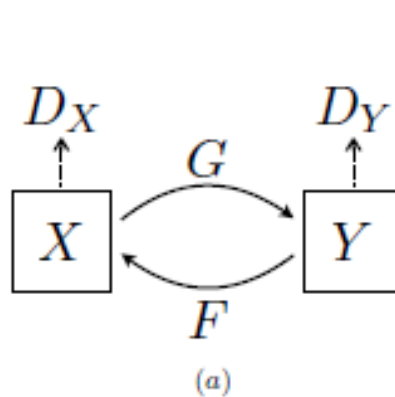
DiscoGAN



CycleGAN



DiscoGAN



CycleGAN

전체 동작원리는 동일!

전체 동작원리는 동일!

그럼 뭐가 다른거야?

# CycleGAN 만든 사람이 알려줌!



저는 다른데여?

Finding connections among images using CycleGAN

조회수 2,632회

40 0 공유 ...

NAVER naver d2  
게시일: 2017. 10. 23.

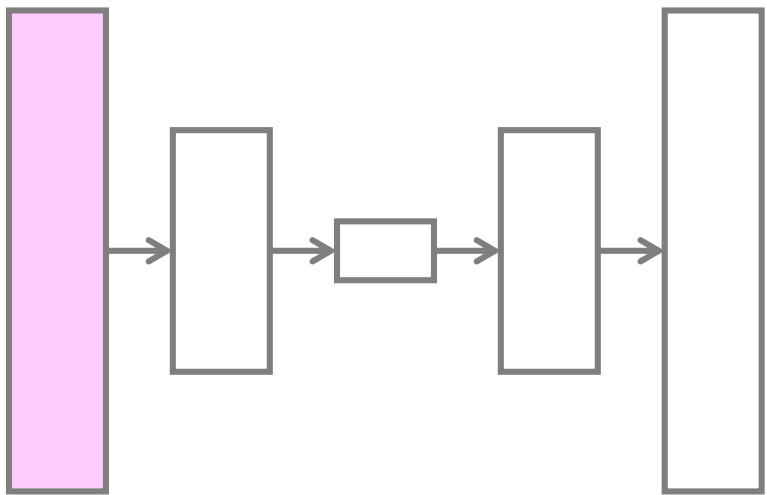
구독 2.3천

발표자: 박태성 (UC Berkeley 박사과정)  
발표일: 2017.6.



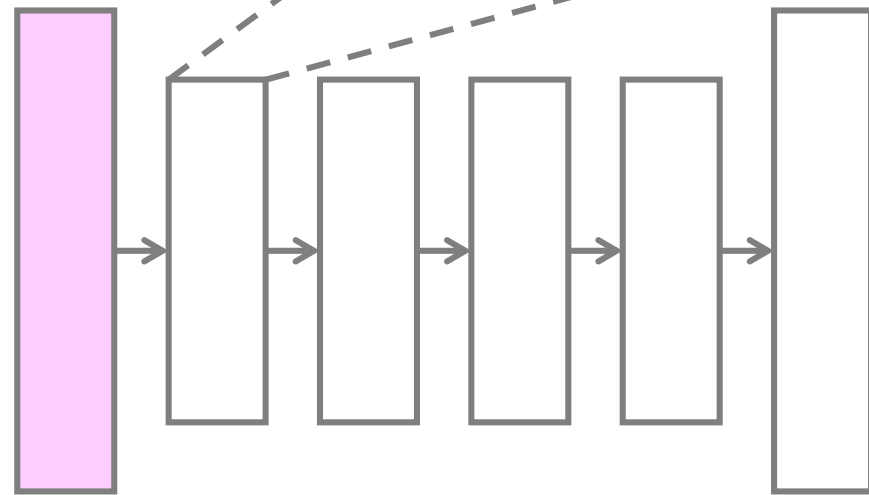
# G 구조가 다름

DiscoGAN

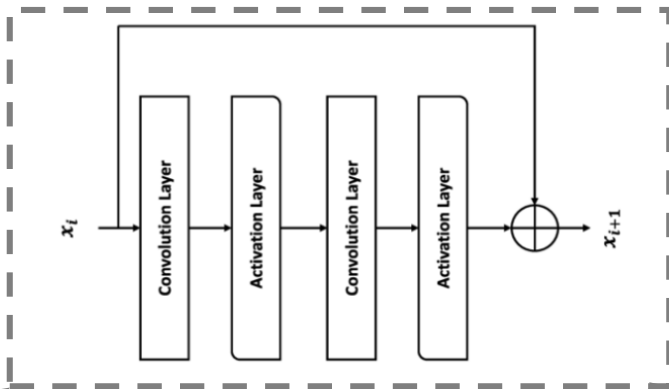


Encoder-decoder

CycleGAN



ResNet  
[He et al.]



왜 다른거야?

# 목적이 다름

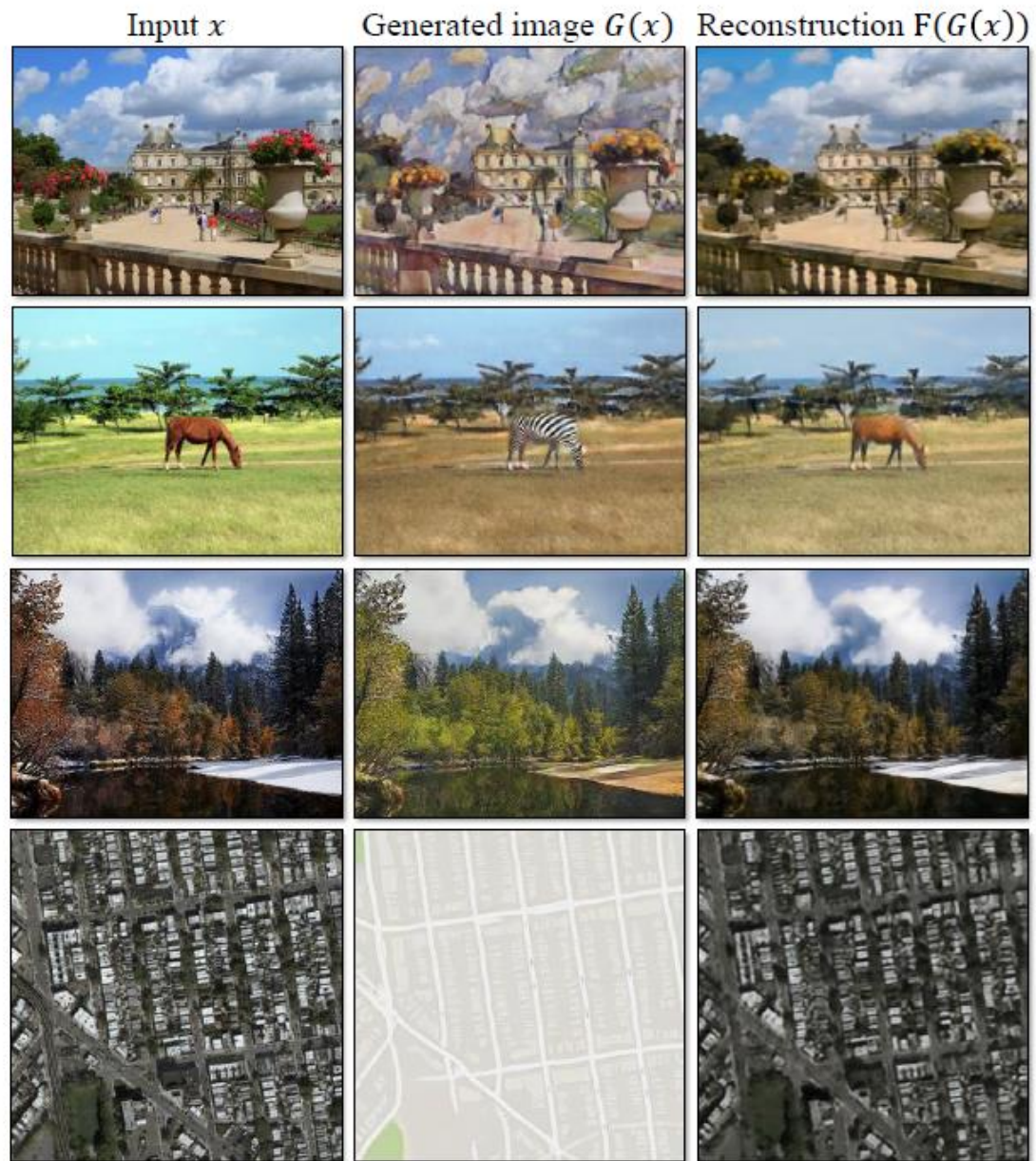
## DiscoGAN

- 두 이미지 간 관계를 파악해보자!
- 디테일보다는 전체적인 변화에 집중!  
즉, 높은 해상도는 바라지 않아!
- 물체 특성(방향 등)을 유지시키면서 물체 형태를 바꿔보자!

## CycleGAN

- 컴퓨터 그래픽을 사진처럼 만들어 보자!
- 지금까지의 GAN은 32픽셀짜리 이미지를 생성하는 수준이었는데 고해상도 이미지를 생성해보자!
- 실제 사진처럼 보이는 게 목적이니까 오버피팅 일어나게 하는 것도 나쁘지 않아!

# 잘 됨?



# 잘 됨?



$$L_{GAN}(G(x), y) + \|F(G(x)) - x\|_1 + L_{GAN}(F(y), x) + \|G(F(y)) - y\|_1$$

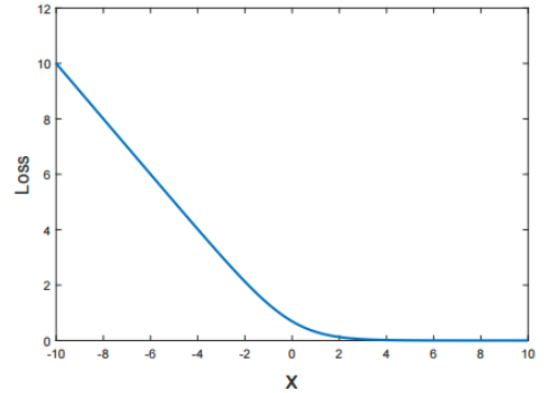


CycleGAN의 특징이 있다면?

# Least Square GAN [Mao et al.]

$$\mathcal{L}_{GAN}(G, D_y, X, Y)$$

$$= \mathbb{E}_{y \sim p_{data}(y)} [\log D_Y(y)] + \mathbb{E}_{x \sim p_{data}(x)} [\log(1 - D_Y(G(x)))]$$

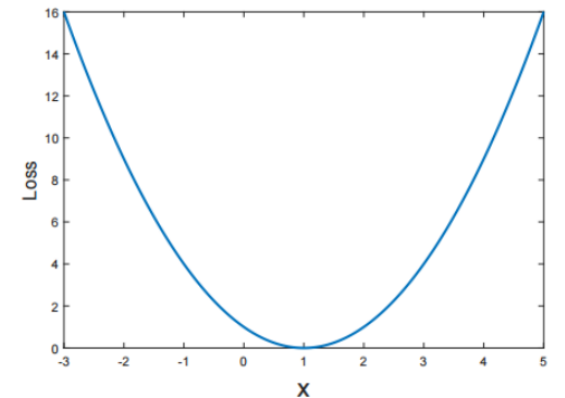


$$\mathcal{L}_{LSGAN}(D, X, Y)$$

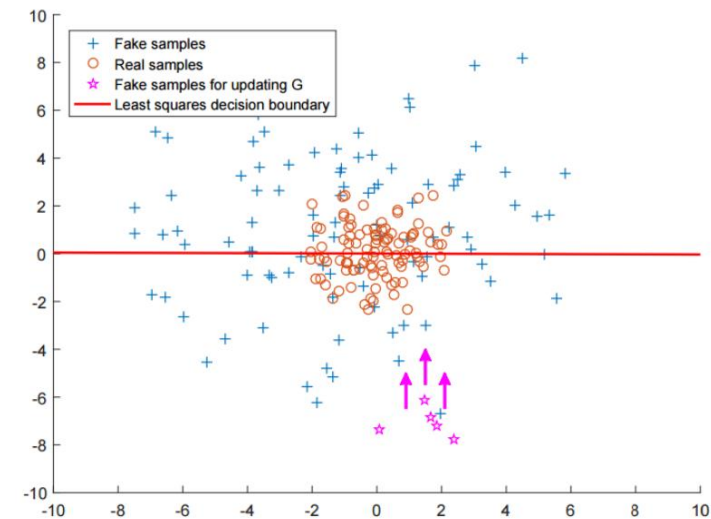
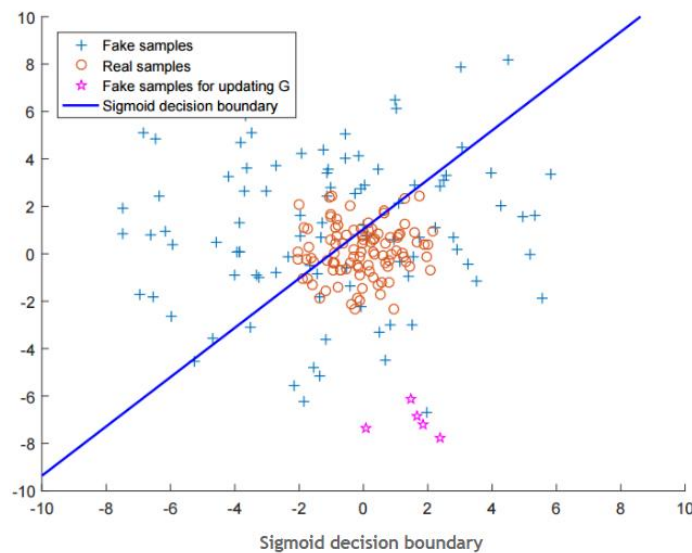
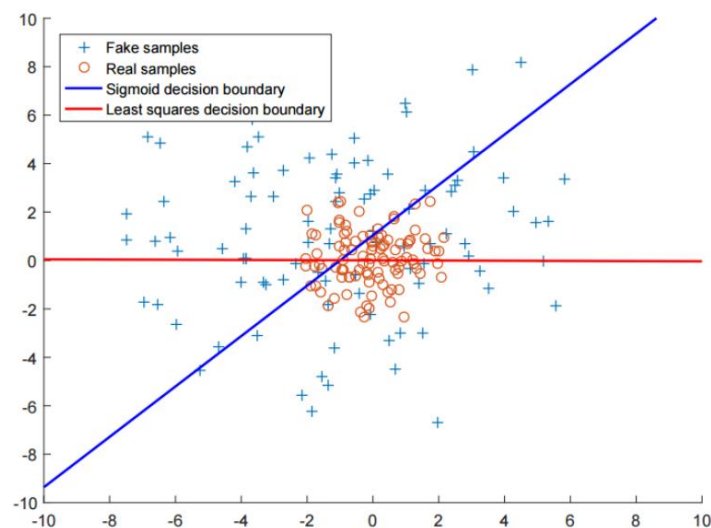
$$= \mathbb{E}_{y \sim p_{data}(y)} [(D(y) - 1)^2] + \mathbb{E}_{x \sim p_{data}(x)} [(D(G(x)))^2]$$

$$\mathcal{L}_{LSGAN}(G, X, Y)$$

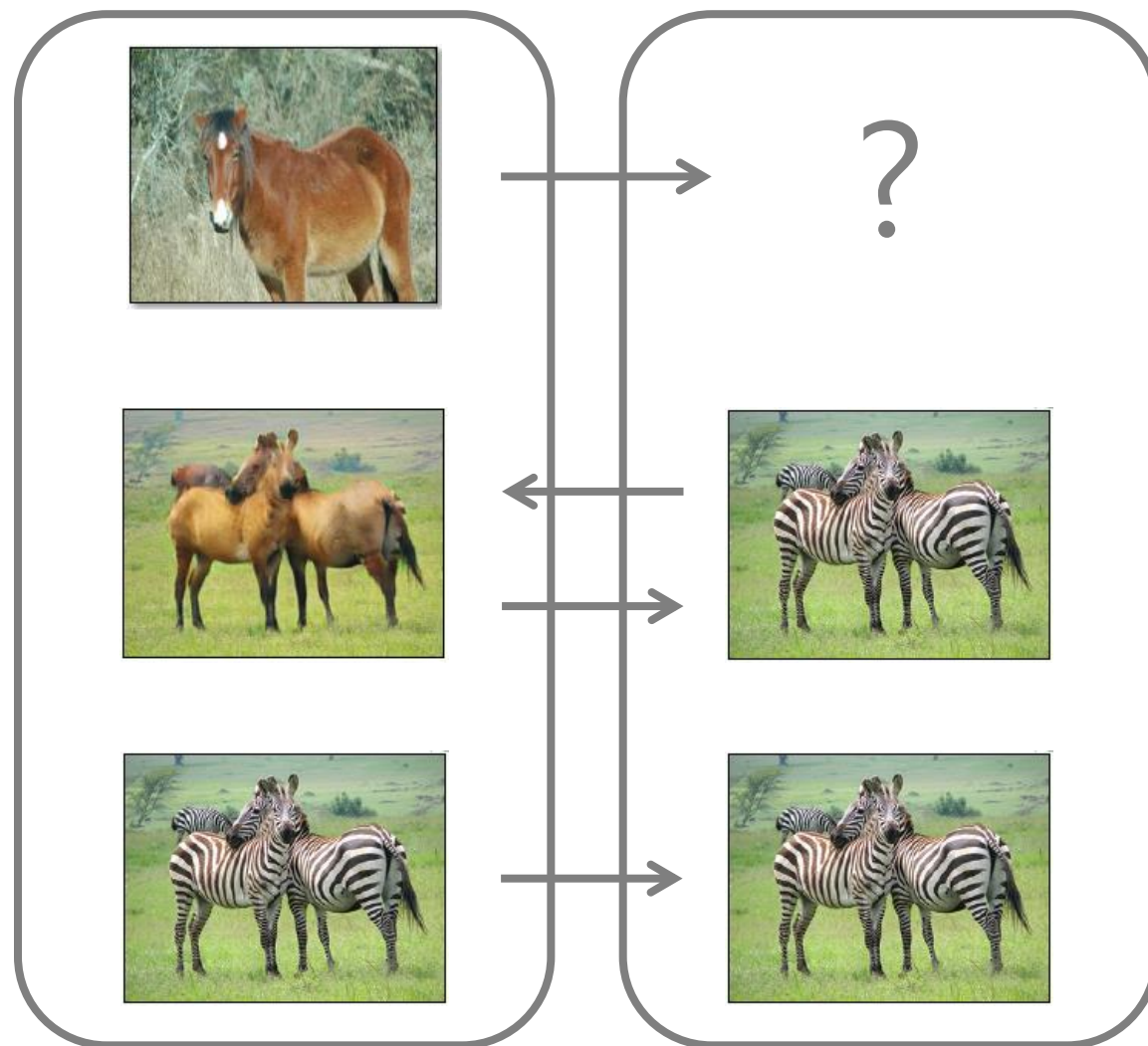
$$= \mathbb{E}_{x \sim p_{data}(x)} [(D(G(x)) - 1)^2]$$



# Least Square GAN [Mao et al.]

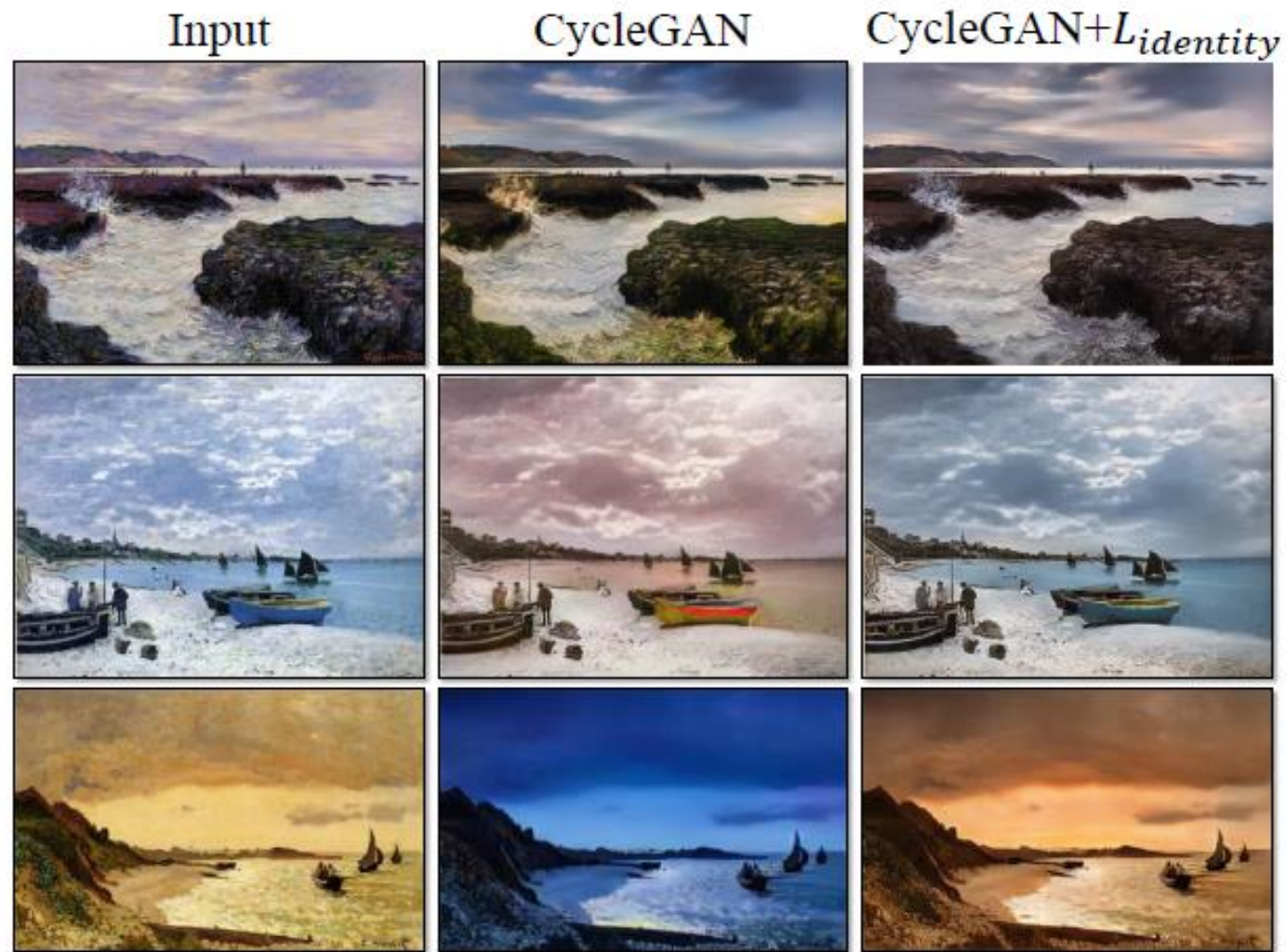


# L1 Loss



*stable  
guiding  
force*

# L1 Loss



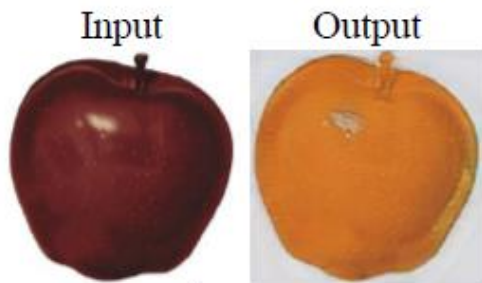


Replay buffer!

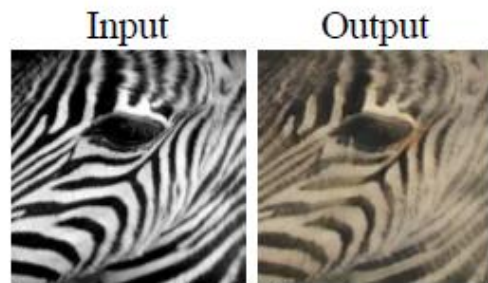
Replay buffer!

G가 전에 만든 50개 갖고 D 복습!

# 이런 것들은 잘 안됨...



apple → orange



zebra → horse



winter → summer



dog → cat



cat → dog



Monet → photo



photo → Ukiyo-e



photo → Van Gogh



iPhone photo → DSLR photo



Horse → Zebra



ImageNet “wild horse” training images

그래서 이걸 어디에 쓰면 됨?



# CG2Real : GTA 게임화면을 실제처럼!



GTA → Cityscapes

게임할라고 만든거임?

게임할라고 만든거임?

ㄴ ㄴ 이거로 무인자동차 만들거임!









# 게임하라고 산 거 아님! 연구할거임!

**MIT  
Technology  
Review**

Log in / Create an account

Topics+The DownloadMagazineEvents

1



**Intelligent Machines**

## Self-Driving Cars Can Learn a Lot by Playing Grand Theft Auto

Hyper-realistic computer games may offer an efficient way to teach AI algorithms about the real world.

by Will Knight   September 12, 2016

**Spending thousands of hours playing Grand Theft Auto might have** questionable benefits for humans, but it could help make computers significantly more intelligent.

# Domain Adaption with CycleGAN



Train on CycleGAN data



Test on real images

		Per-class accuracy	Per-pixel accuracy
Oracle (Train and test on Real)	실제 학습	60.3	93.1
Train on CG, test on Real	GTA 학습	17.9	54.0
FCN in the wild [Hoffman et al.]	잘 학습	27.1 (+6.0)	-
Train on CycleGAN, test on Real	GTA + CycleGAN 학습	34.8 (+16.9)	82.8

질문 있나요?

감사리:D