Cycle GANs

Deep Fake

Image To Image Translation

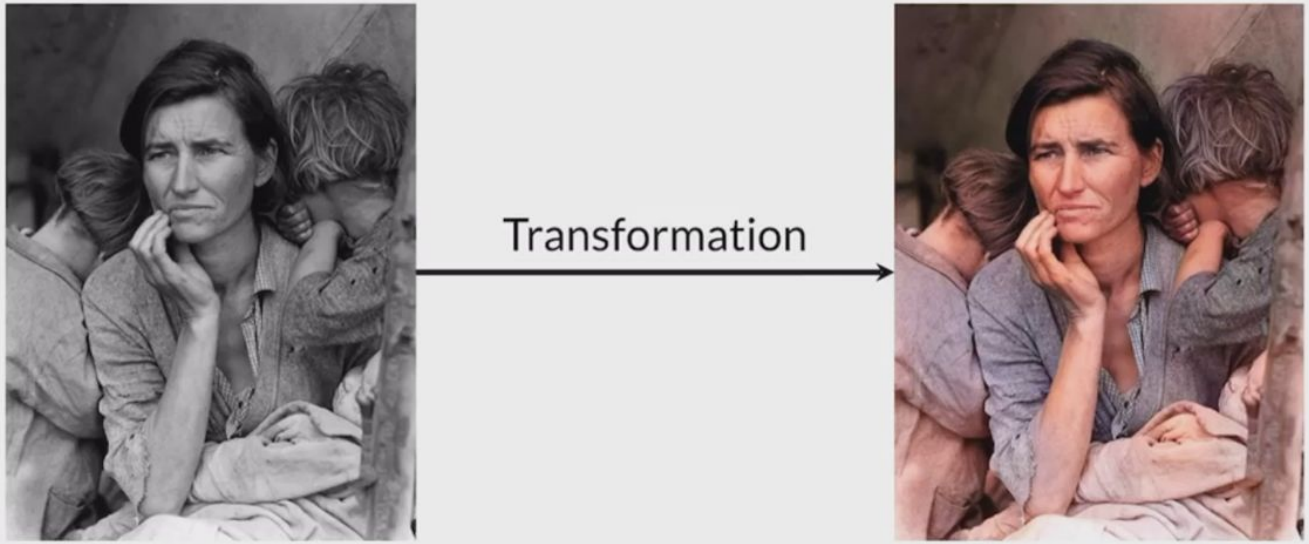


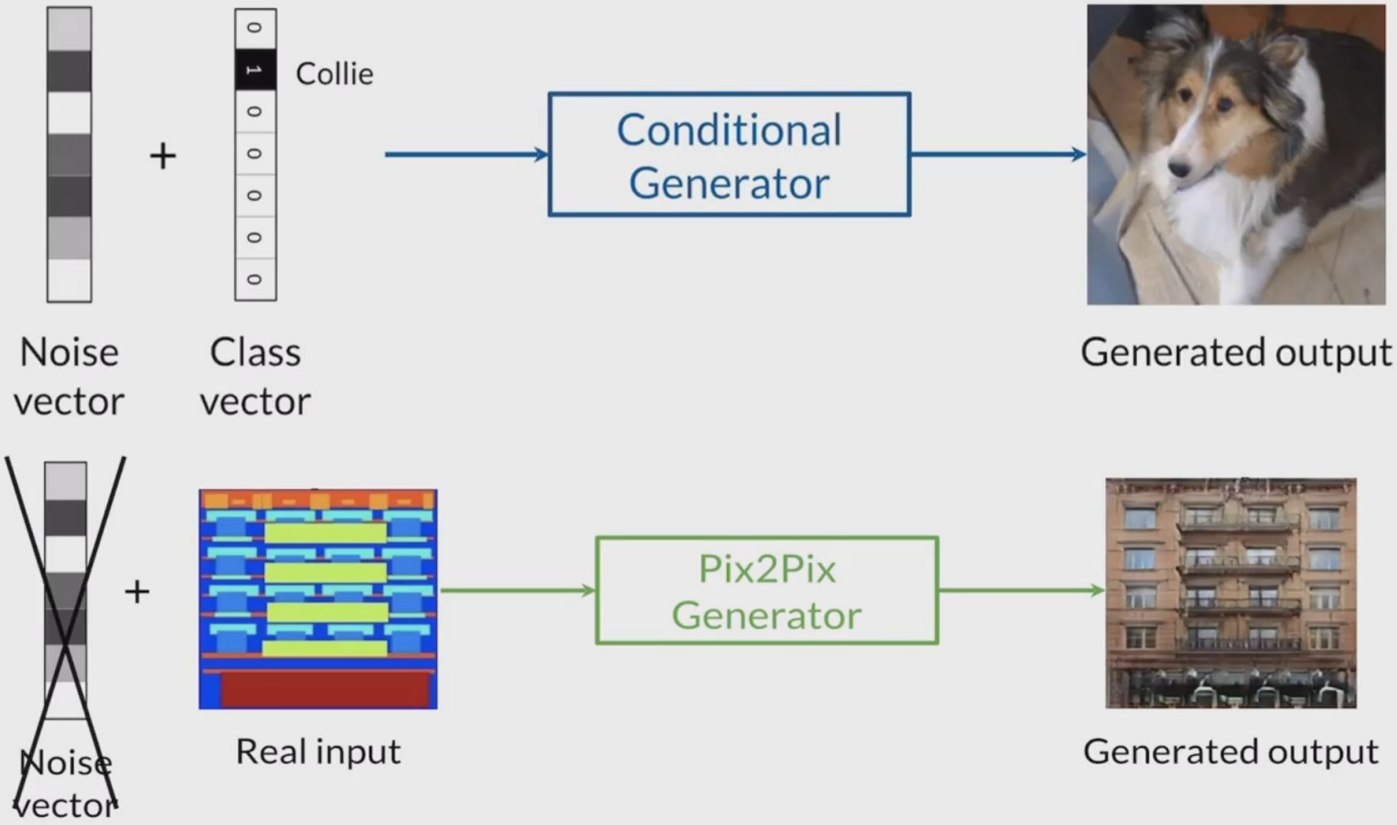
Image To Image Translation

Paired Image To Image Translation

Day to night

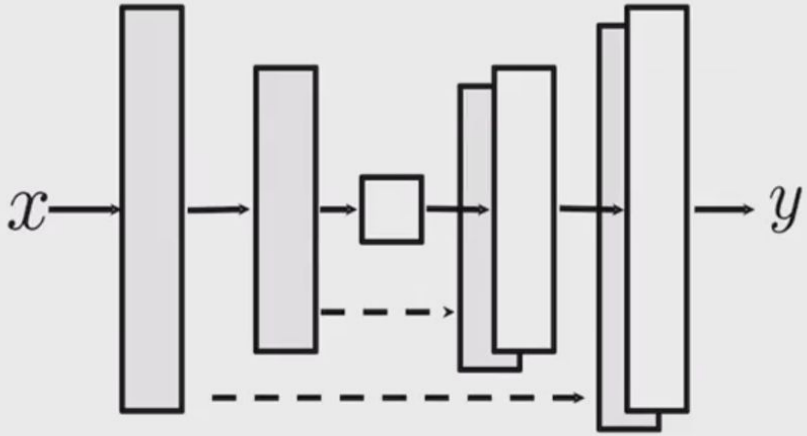
Edges to photo

Pix2Pix

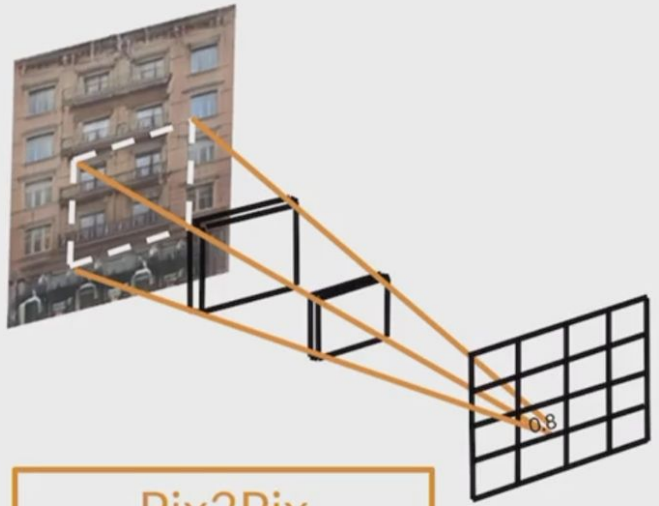

0
1
0
0
0
0
0
Collie
+
Conditional Generator
Noise vector
Class vector
Generated output
+
Pix2Pix Generator
Noise vector
Real input
Generated output

Pix2Pix Discriminator

Pix2Pix Upgrade



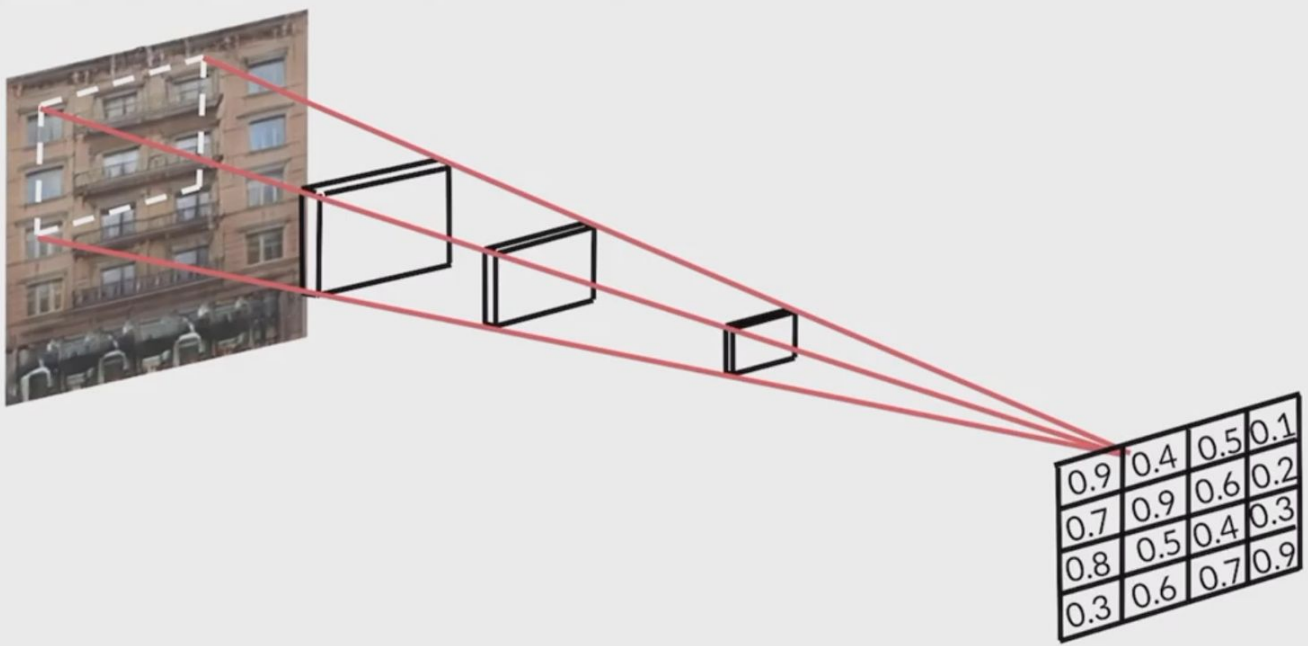
Pix2Pix
Generator



Pix2Pix
Discriminator

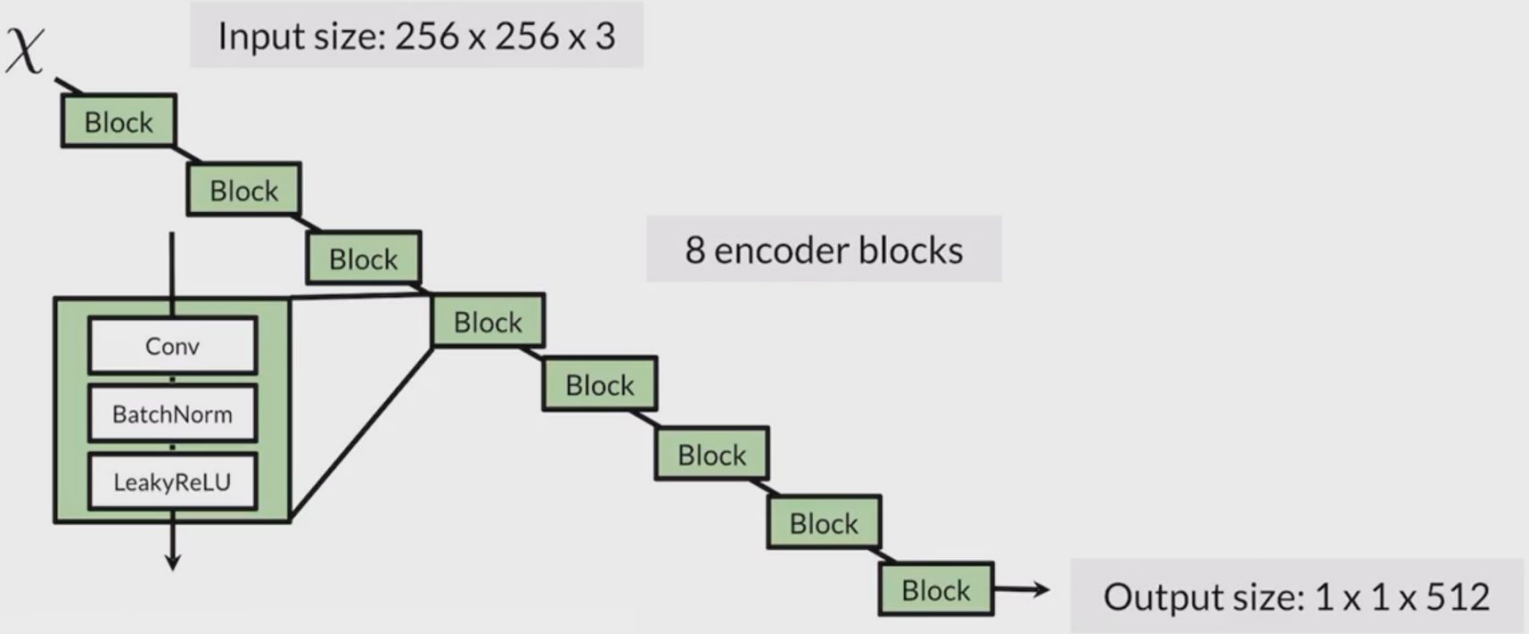
PatchGAN

Discriminator:



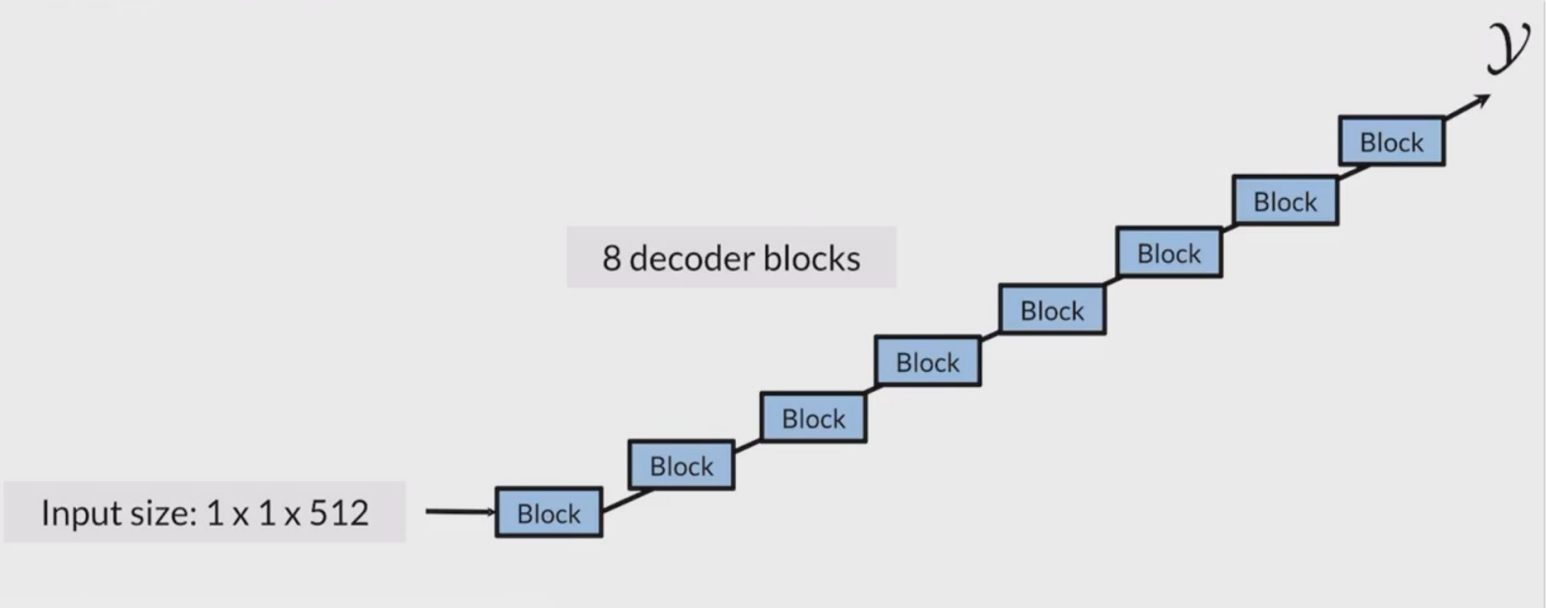
PatchGAN

Encoder:



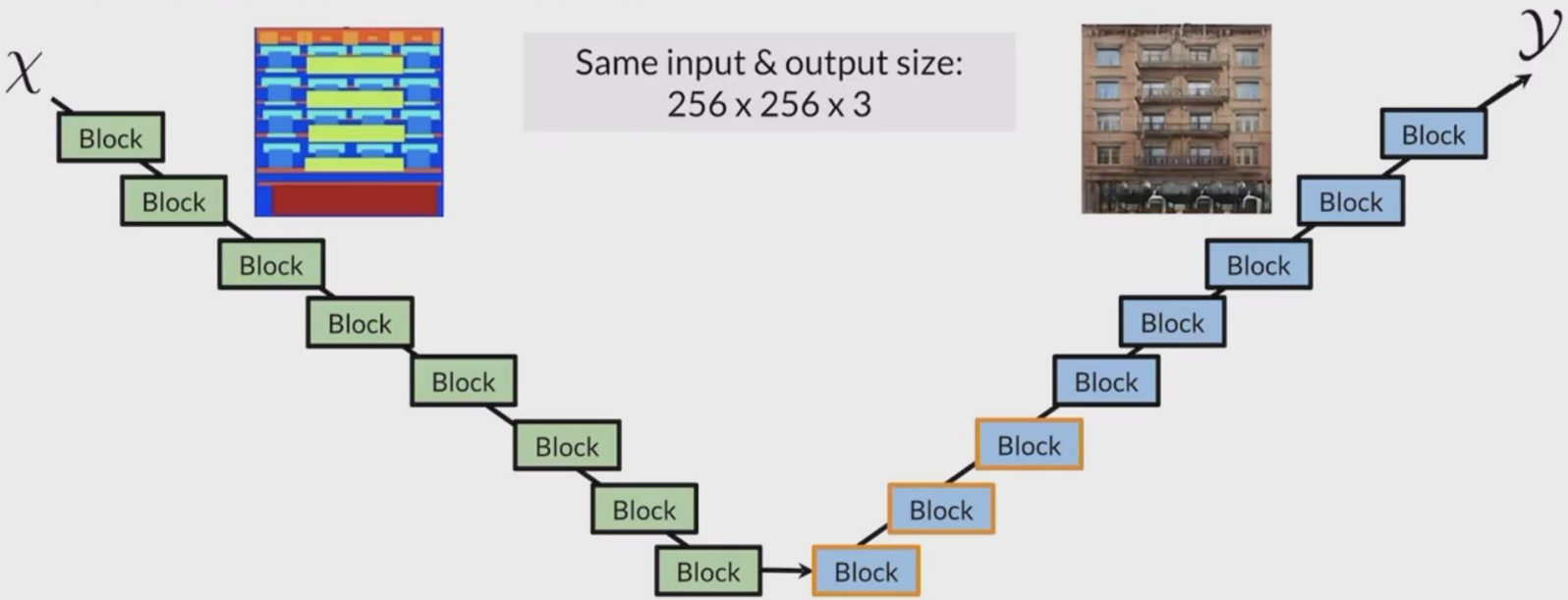
PatchGAN

Decoder:



PatchGAN

Generator:



Additional Loss Term

$$\min_{g} \max_{c} \text{Adversarial Loss} + \lambda * \text{Other loss term}$$

Pixel Distance Loss Term

$$\sum_{i=1}^{n} \left| \text{Generated output} - \text{Real output} \right|$$

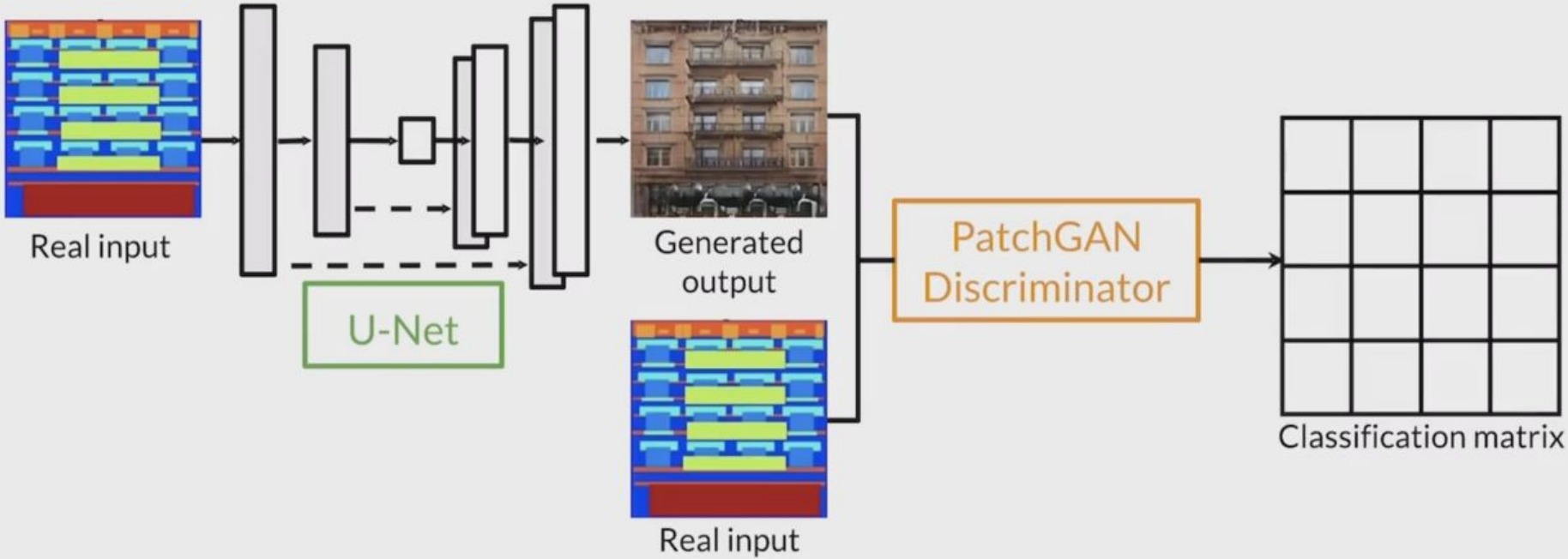
$$\min_{g} \max_{c} \text{Adversarial Loss} + \lambda * \text{Pixel loss term}$$

Pix2Pix Generator Loss

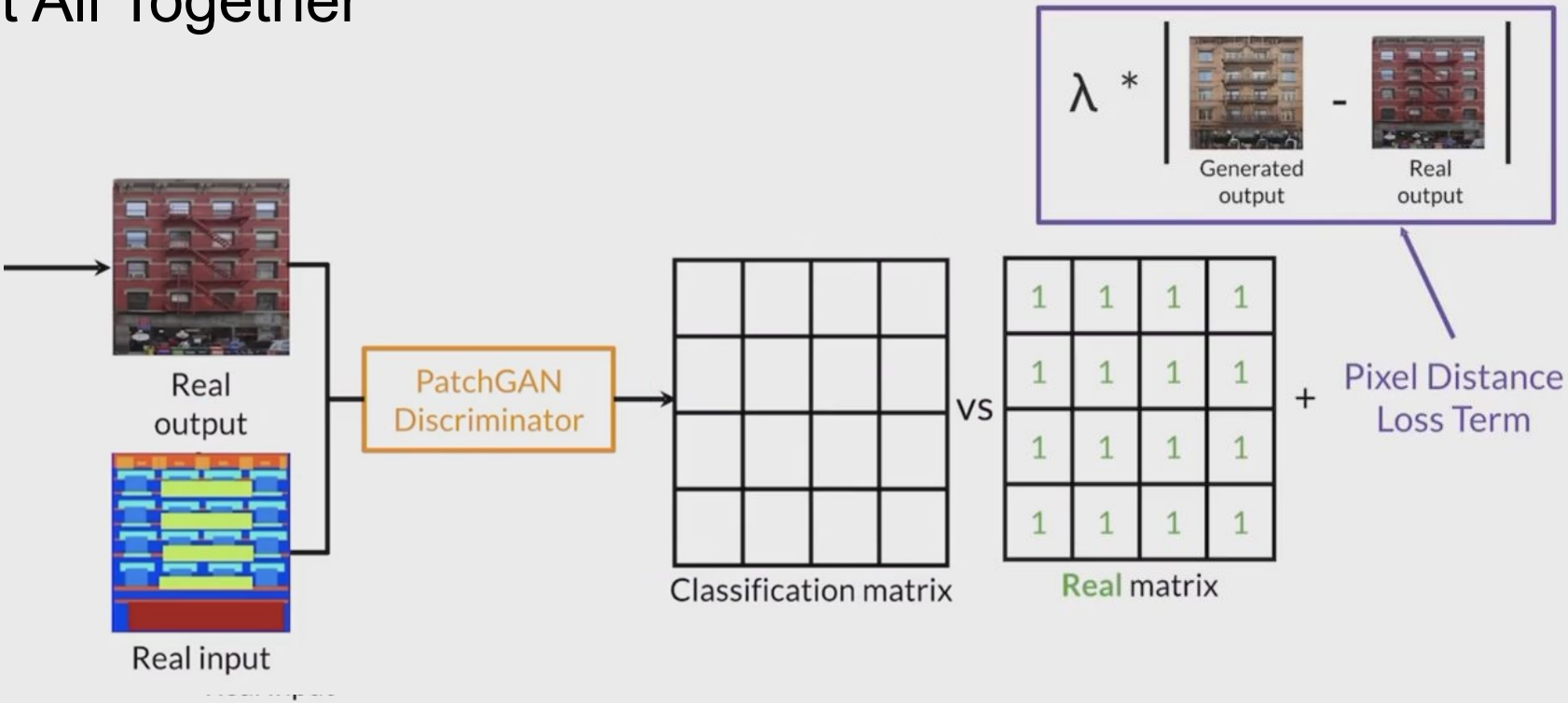
$$\text{BCE Loss} + \lambda \sum_{i=1}^{n} \left| \text{  } - \text{  } \right|$$

$$\text{BCE Loss} + \lambda \sum_{i=1}^{n} \left| \textit{generated\_output} - \textit{real\_output} \right|$$

Put All Together



Put All Together



Paired vs Unpaired

Edges to photo

Paired generation

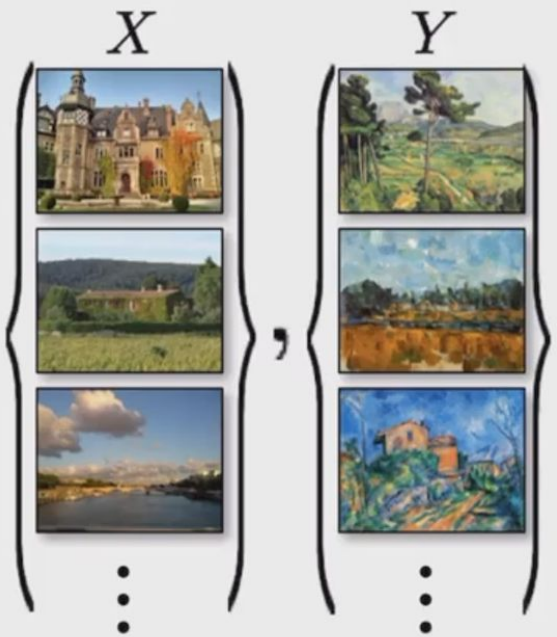
Monet to photo

Unpaired generation

https://github.com/togheppi/CycleGAN

Paired vs Unpaired

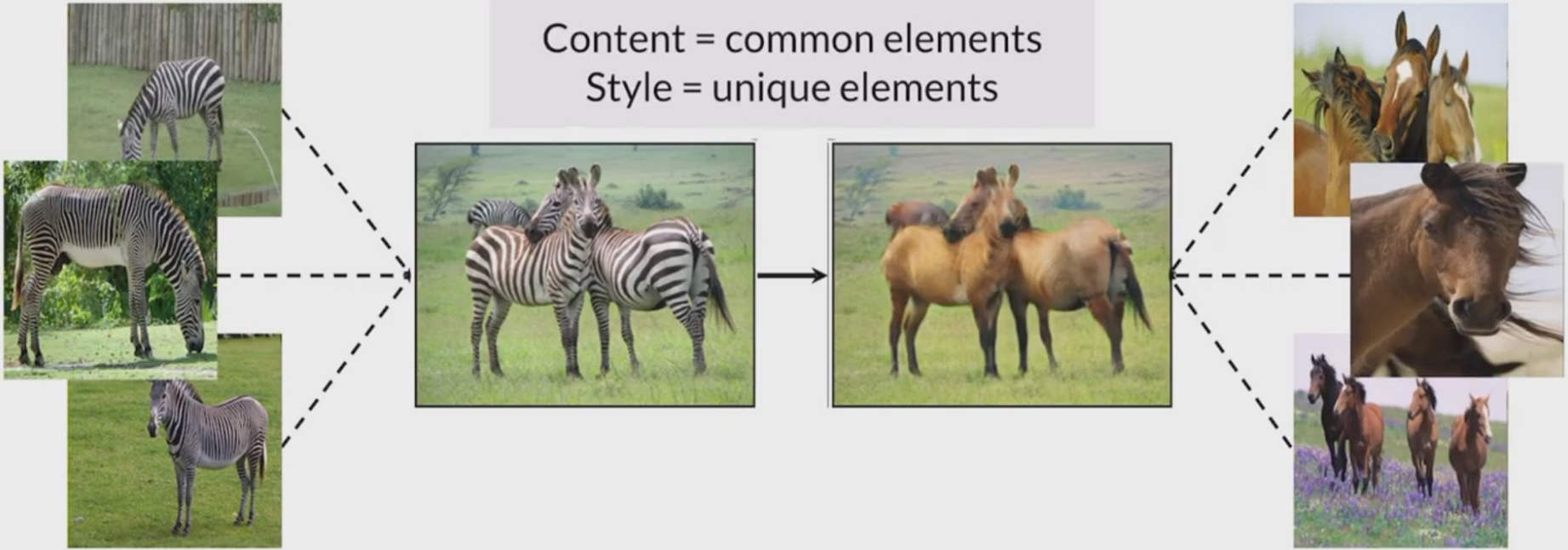
Paired images



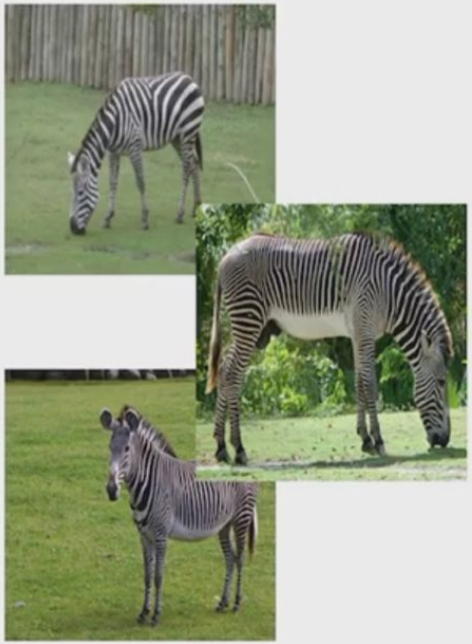
Unpaired images

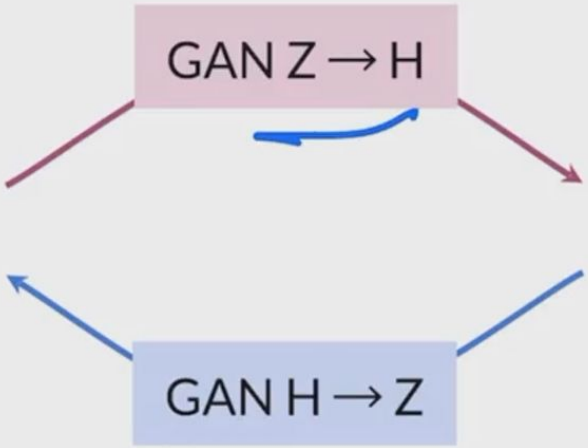
Unpaired Images

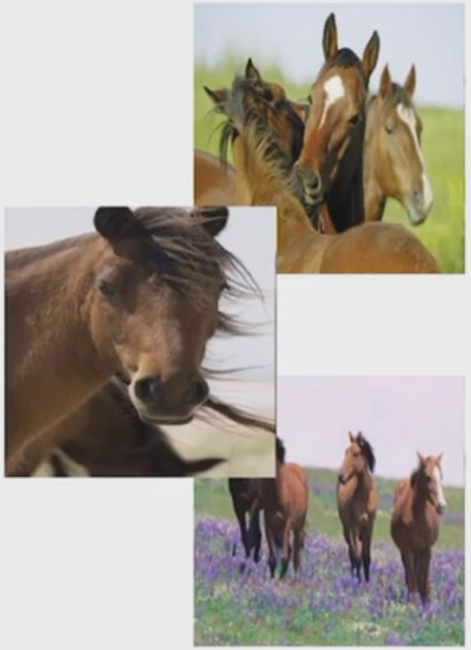
Mapping Between Two Piles



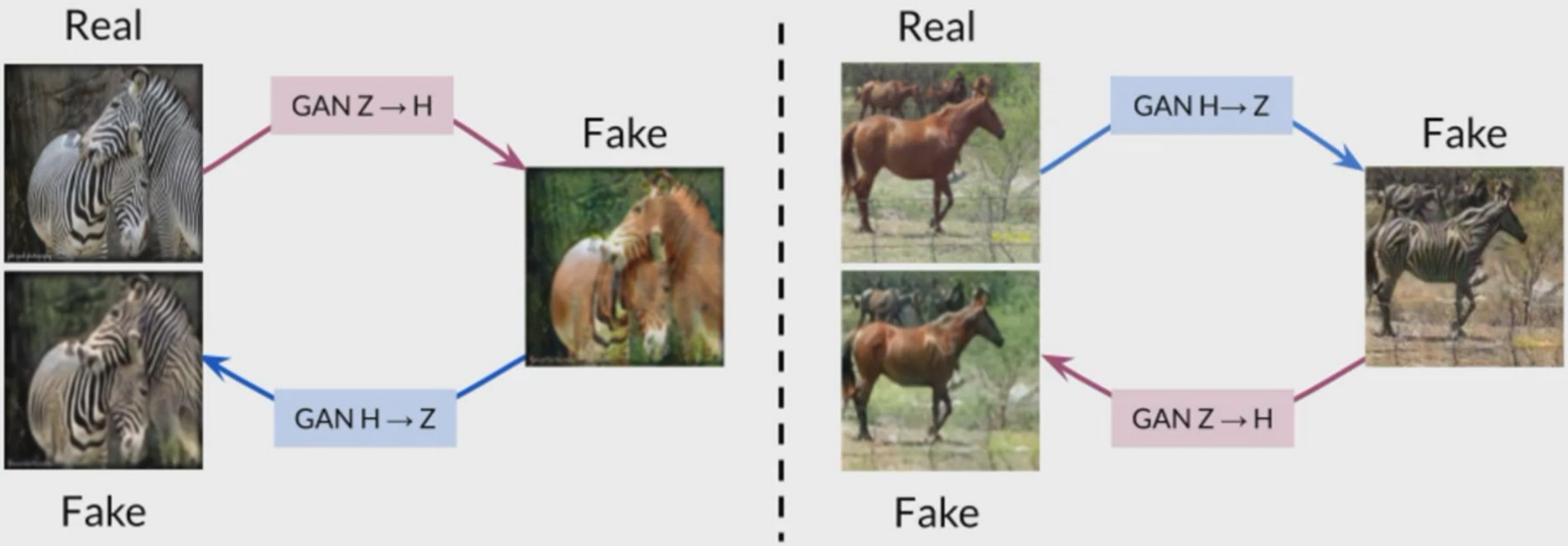
Cycle GANs







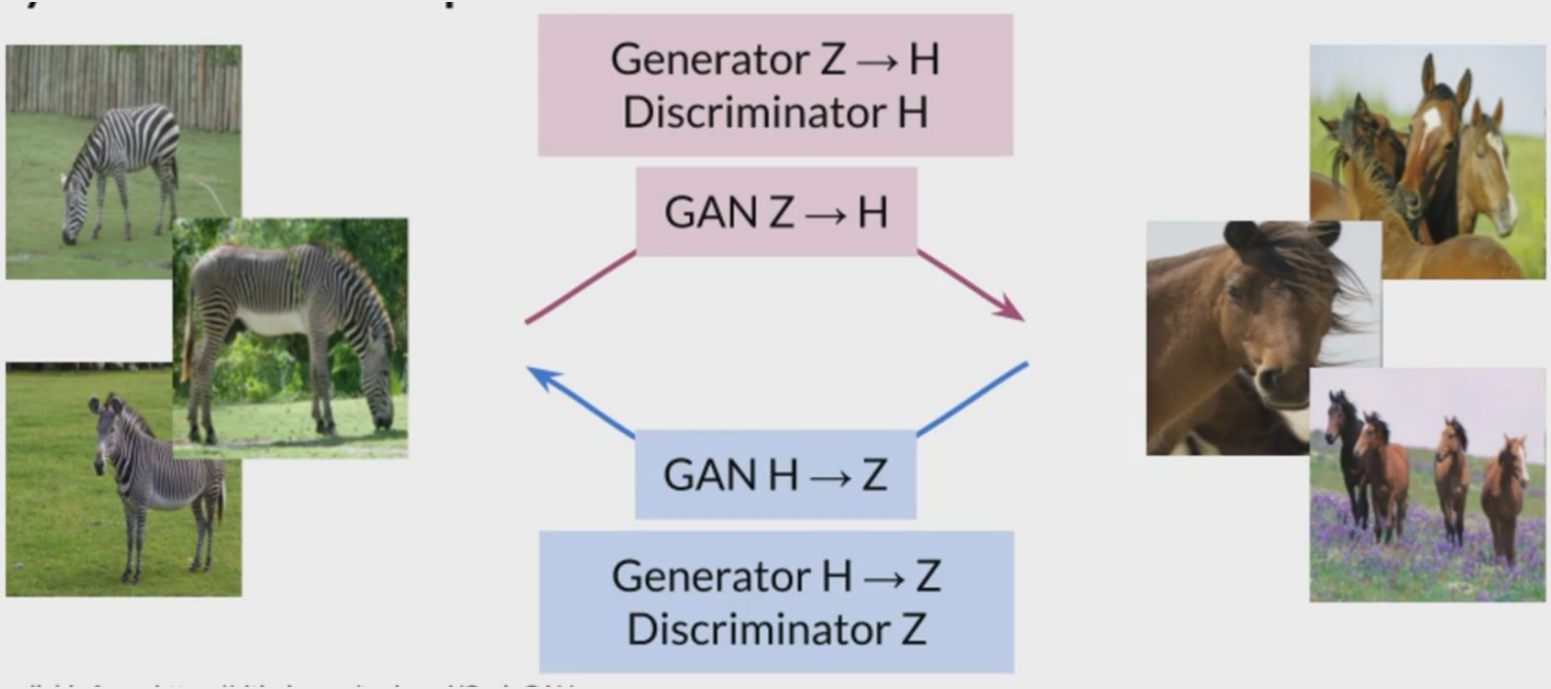
Two GANs



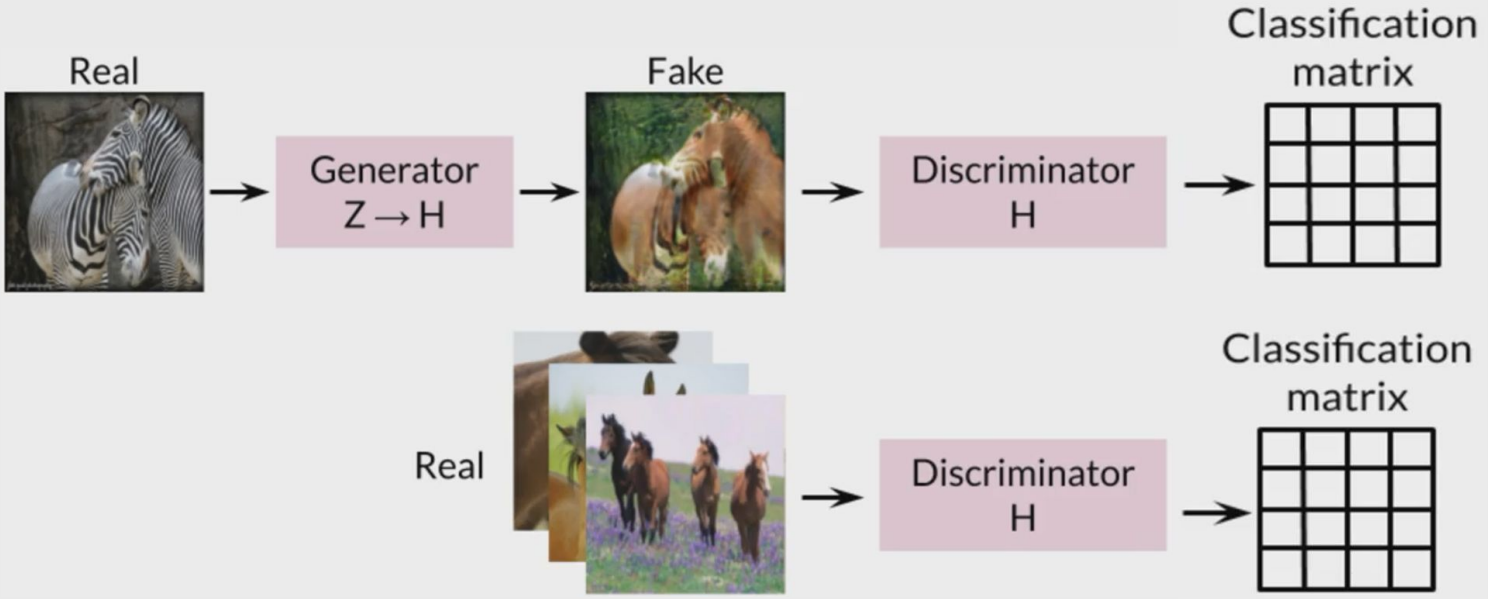
Two GANs

- Two GANs, four components
  - Two generators
  - Two discriminators

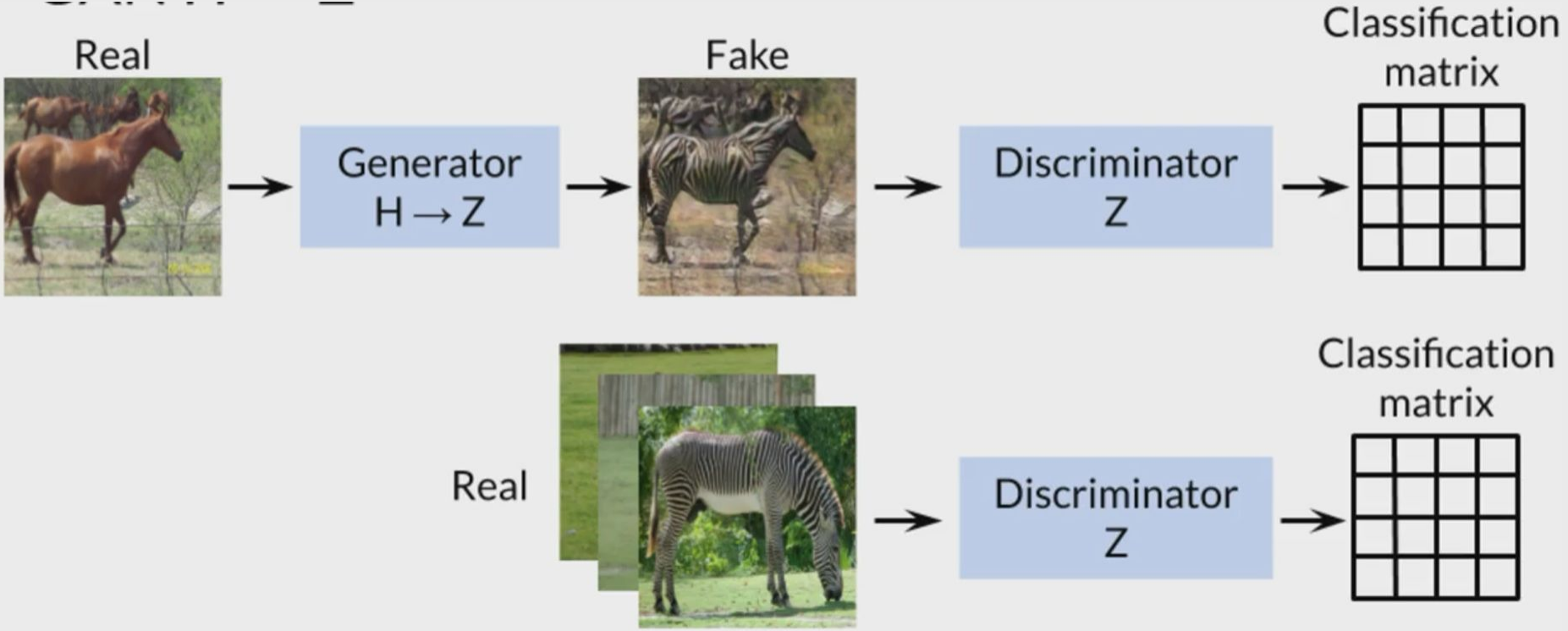
Two GANs


Generator Z → H
Discriminator H
GAN Z → H
GAN H → Z
Generator H → Z
Discriminator Z

GAN Z to H


Real
Generator
Z → H
Fake
Discriminator
H
Classification
matrix
Real
Discriminator
H
Classification
matrix

GAN H to Z


Real
Generator
H → Z
Fake
Discriminator
Z
Classification
matrix
Real
Discriminator
Z
Classification
matrix

Cycle Consistency Loss

$$\sum_i \left| \text{  } - \text{  } \right| + \sum_i \left| \text{  } - \text{  } \right|$$

$Z \rightarrow H \rightarrow Z$

$H \rightarrow Z \rightarrow H$

Cycle Consistency Loss is the sum of both directions

Cycle Consistency Loss

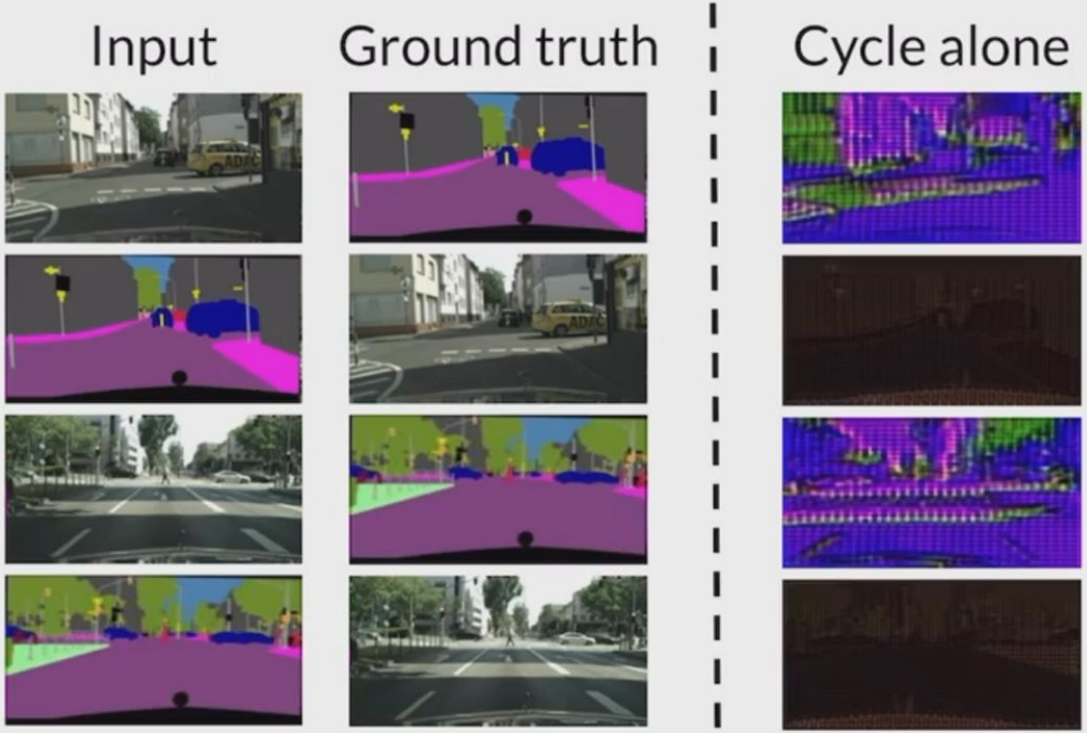
Adversarial Loss + $\sum_i |$  $-$  $|$ + $\sum_i |$  $-$  $|$

Z→H→Z

H→Z→H

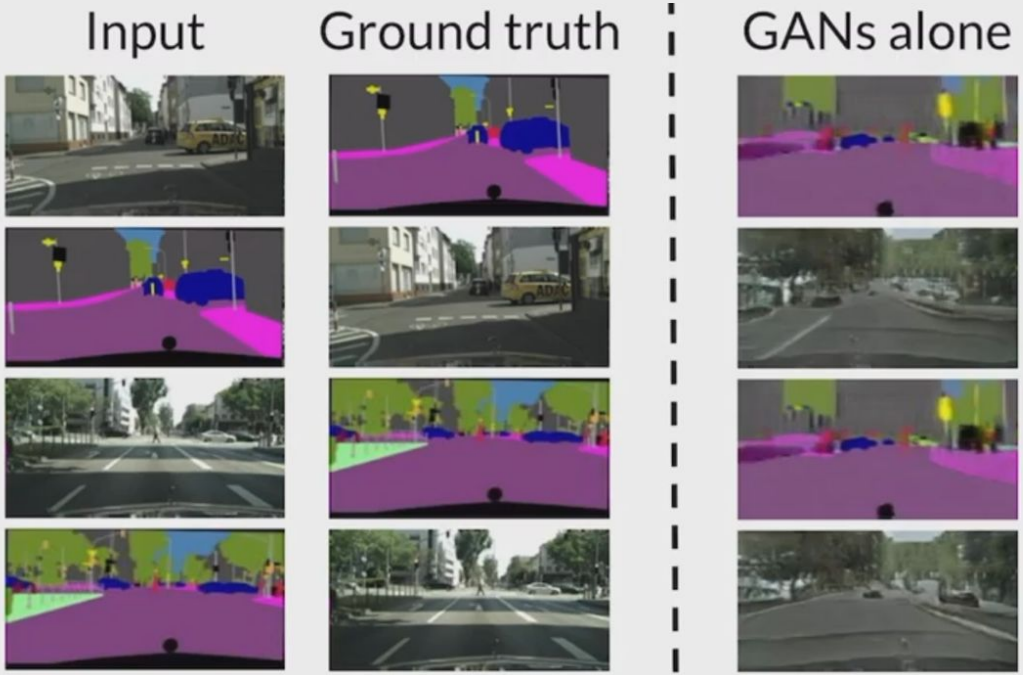
Adversarial Loss + λ * Cycle Consistency Loss

Ablation Studies



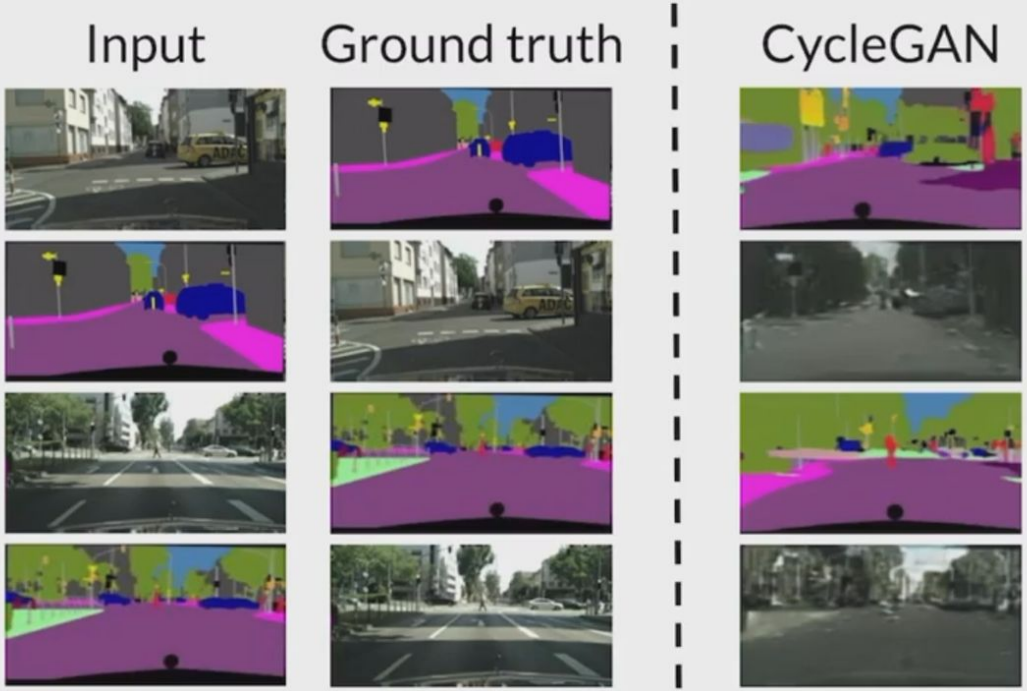
Without Adversarial GAN Loss, outputs are not realistic

Ablation Studies



Without Cycle Consistency Loss, outputs show signs of mode collapse

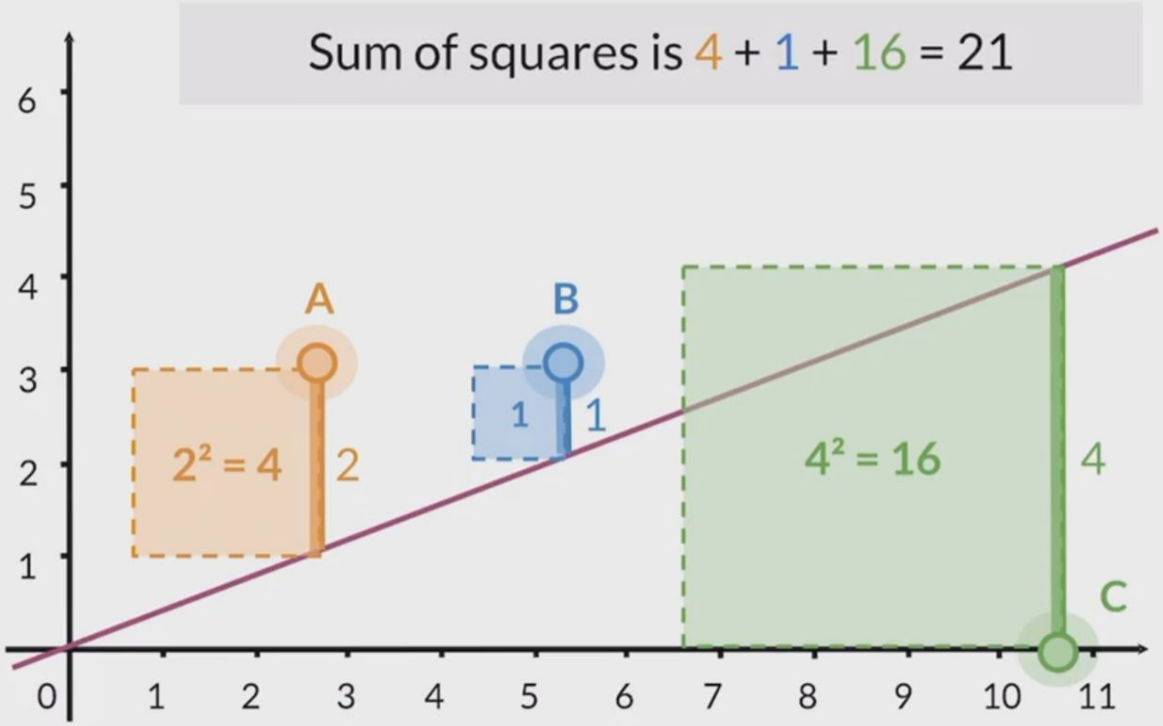
Ablation Studies



CycleGAN uses both
Adversarial Loss and
Cycle Consistency Loss

Adversarial Loss

Least Squares



Adversarial Loss: Discriminator

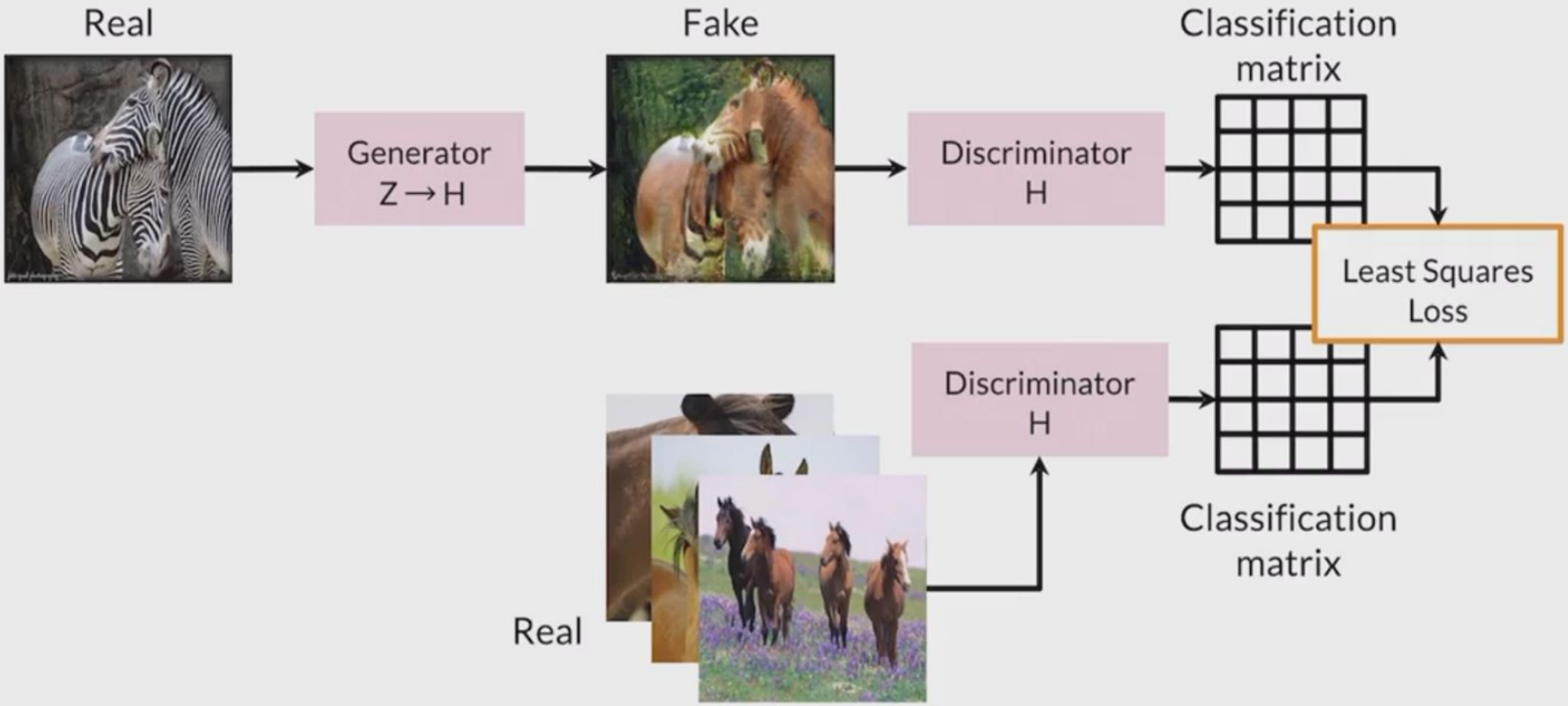
Discriminator Loss

$$\mathbb{E}_{\boldsymbol{x}}\left[(D(\boldsymbol{x})-1)^2\right]+\mathbb{E}_{\boldsymbol{z}}\left[(D(G(\boldsymbol{z})))^2\right]$$

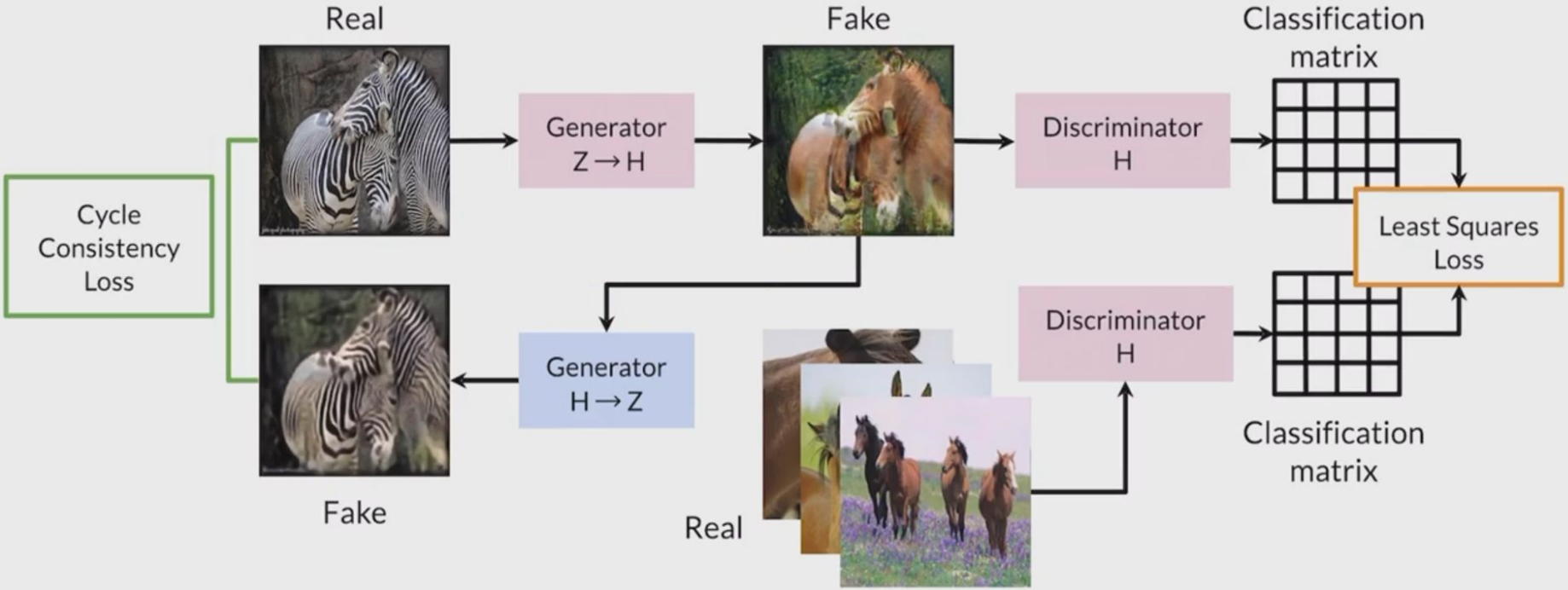
Generator Loss

$$\mathbb{E}_{\boldsymbol{z}}\left[(D(G(\boldsymbol{z}))-1)^2\right]$$

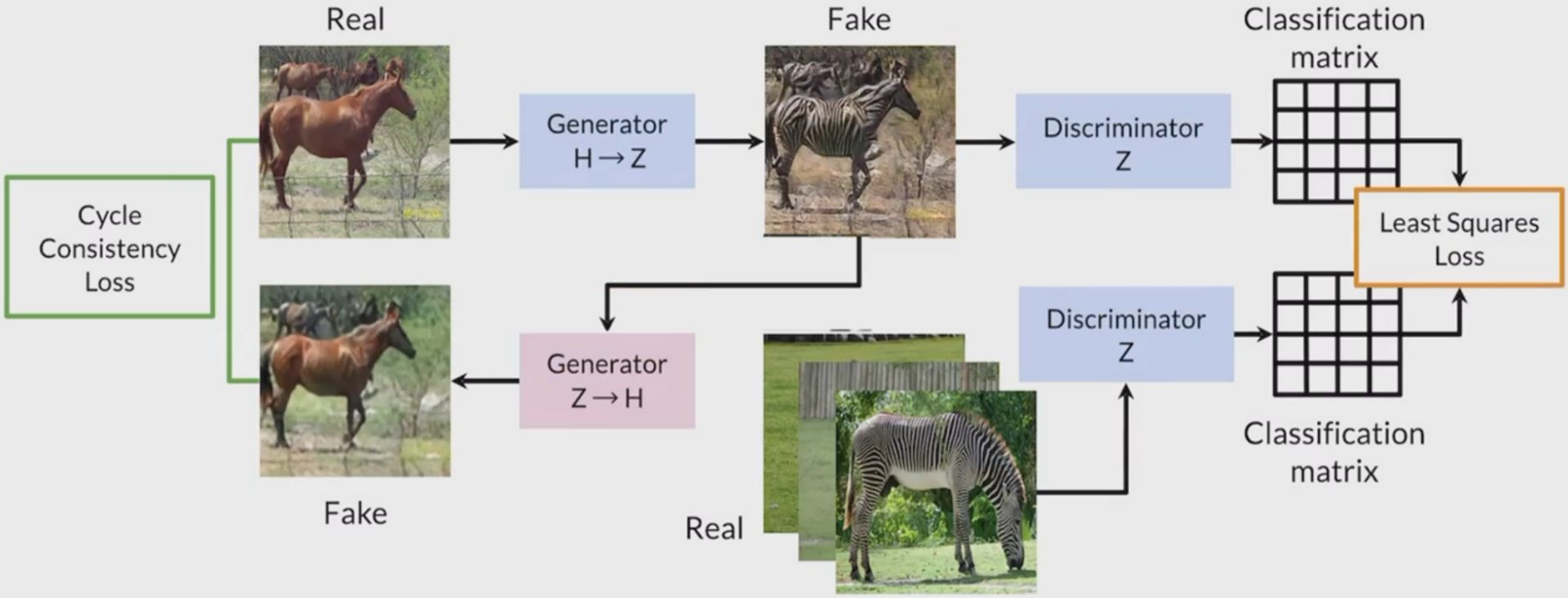
Put All Together



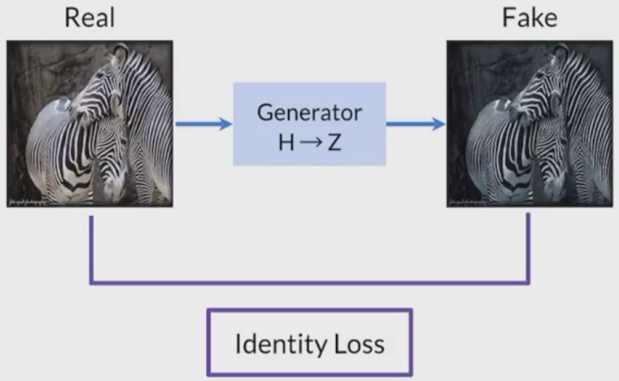
Put All Together

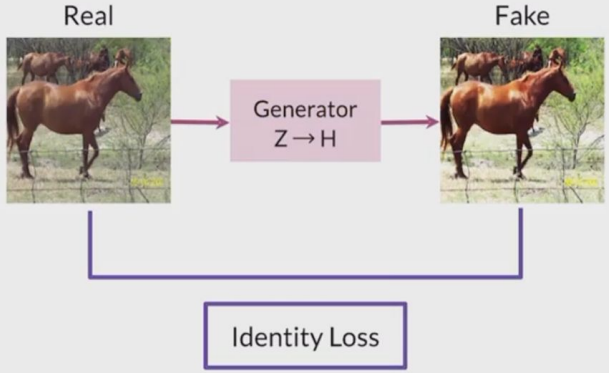


Put All Together



Identity Loss





Put All Together