Generative Adversarial Network

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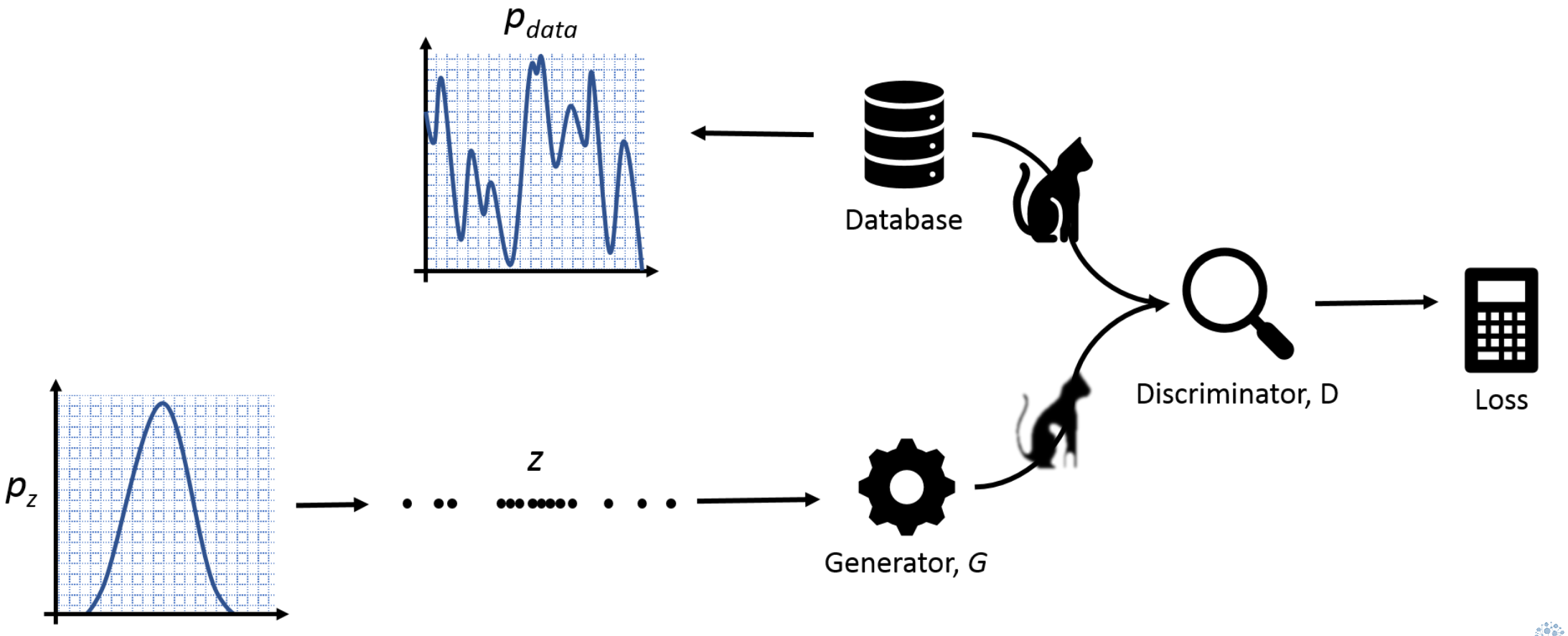
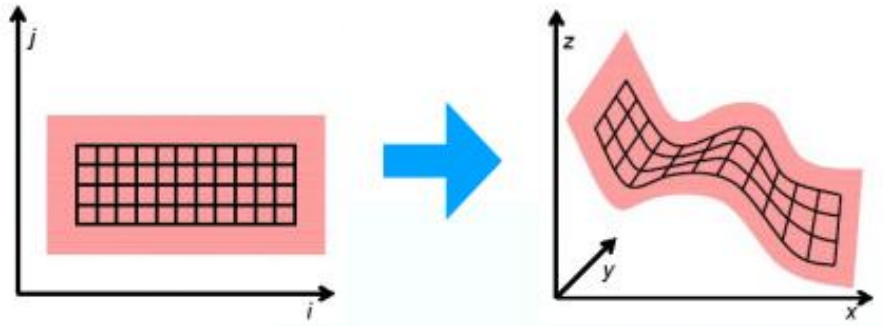
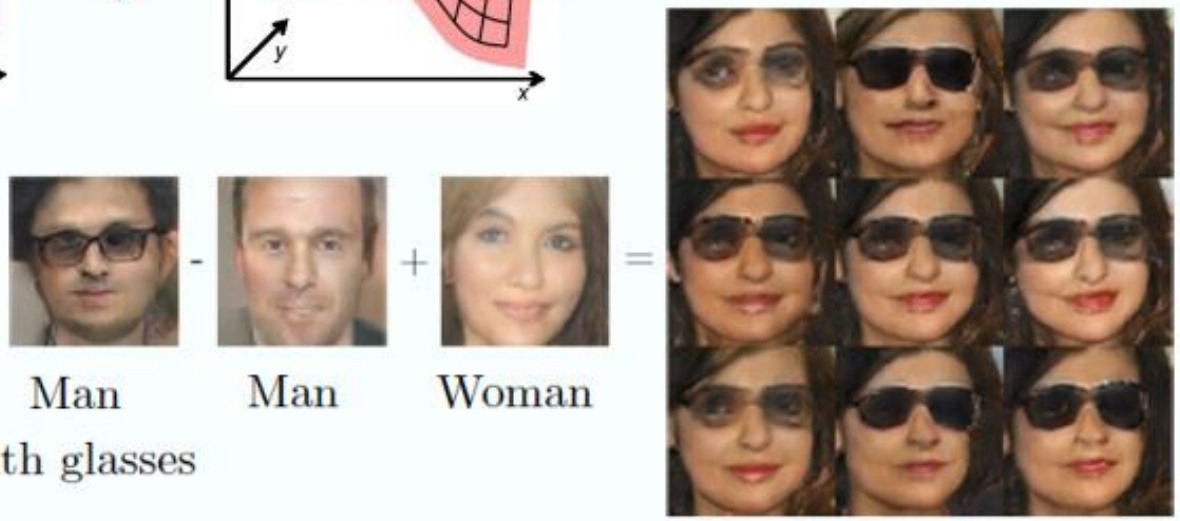
Brief Review of GAN architecture



https://mlnotebook.github.io/post/GAN1/

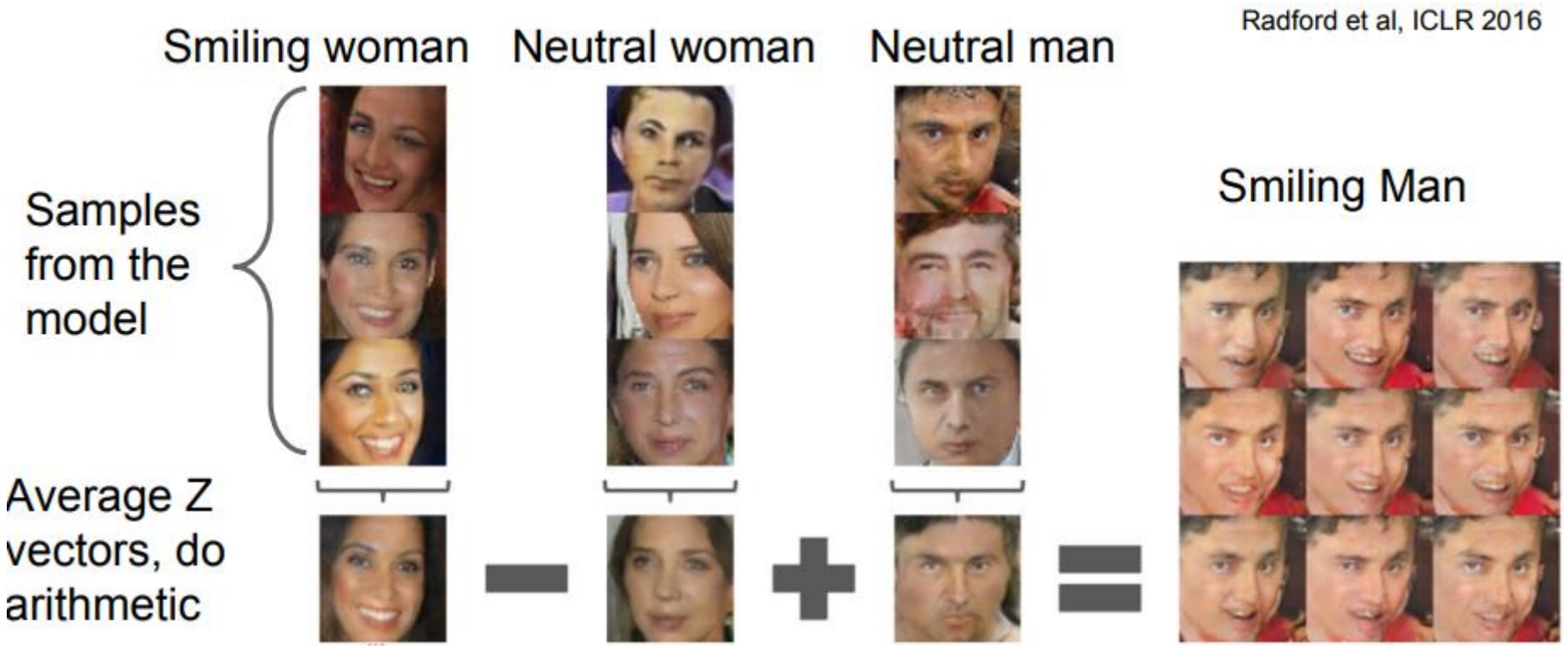
Vector space arithmetic





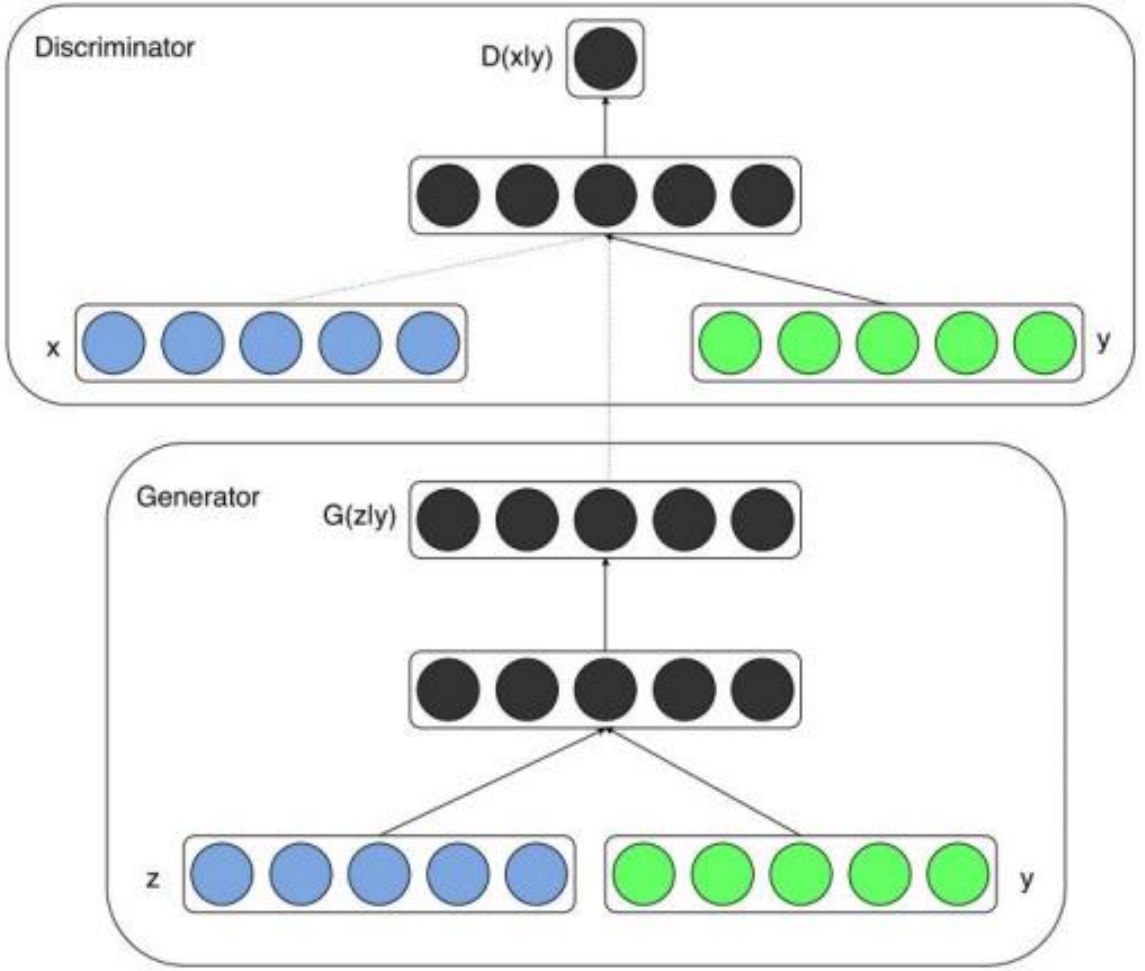
(Radford et al, 2015)

Vector space arithmetic



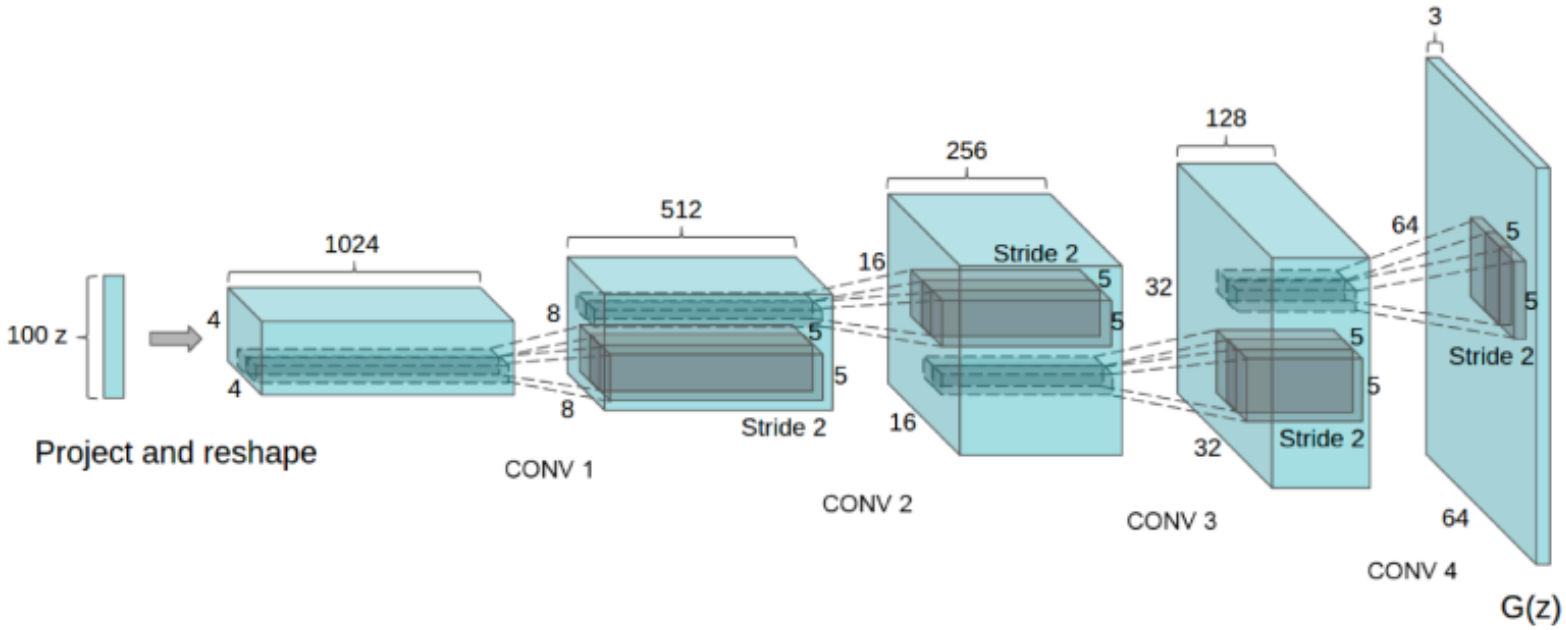
Conditional Generative Adversarial Network

Mirza and Osindero (2014)



Deep convolutional generative adversarial network (DCGAN)

By Redford et al. ICLR 2016

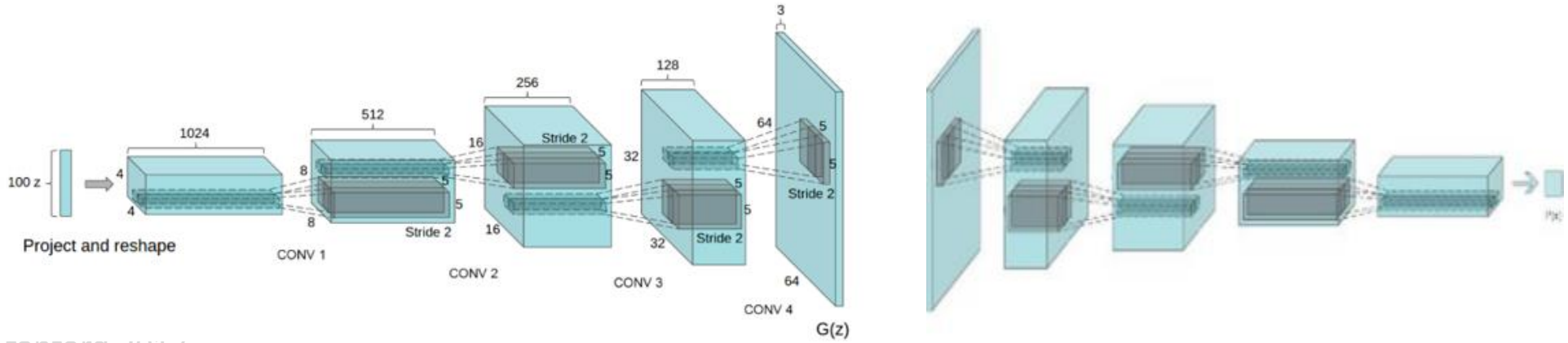


https://carpedm20.github.io/faces/

https://github.com/carpedm20/DCGAN-tensorflow

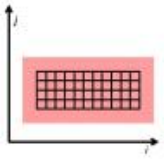
DCGAN

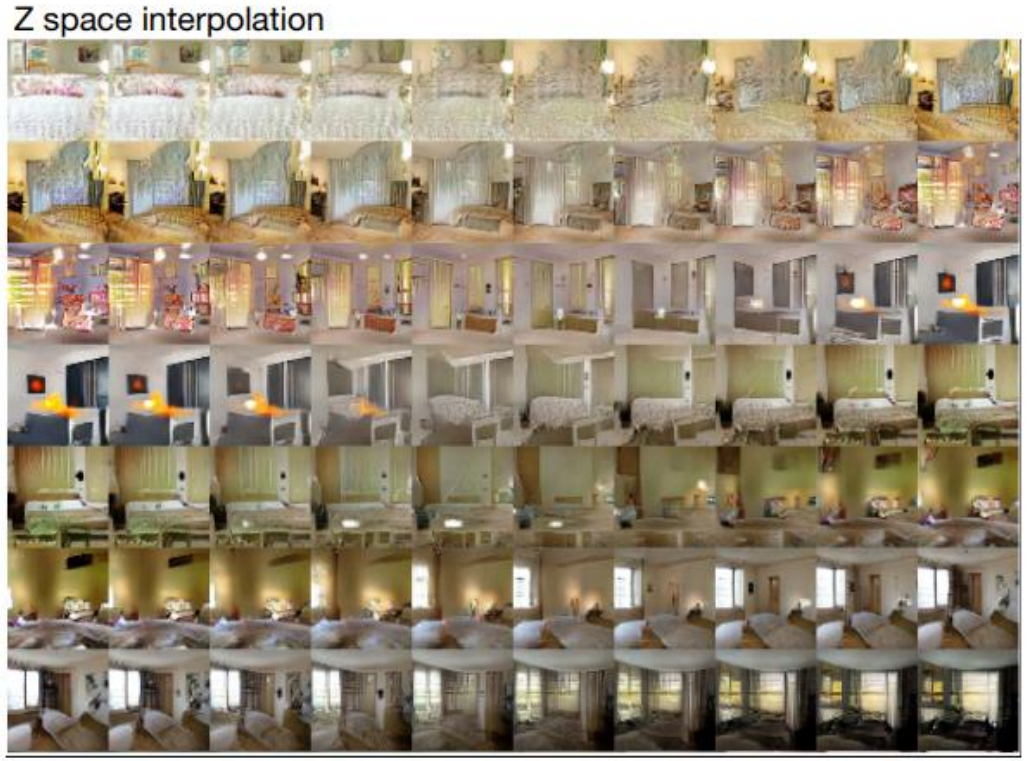
- Deep, Convolutional GANs
- All-convolutional nets
- No pooling / unpooling
- Batch normalization over most layers



Fei-Fei Li Stanford 2017

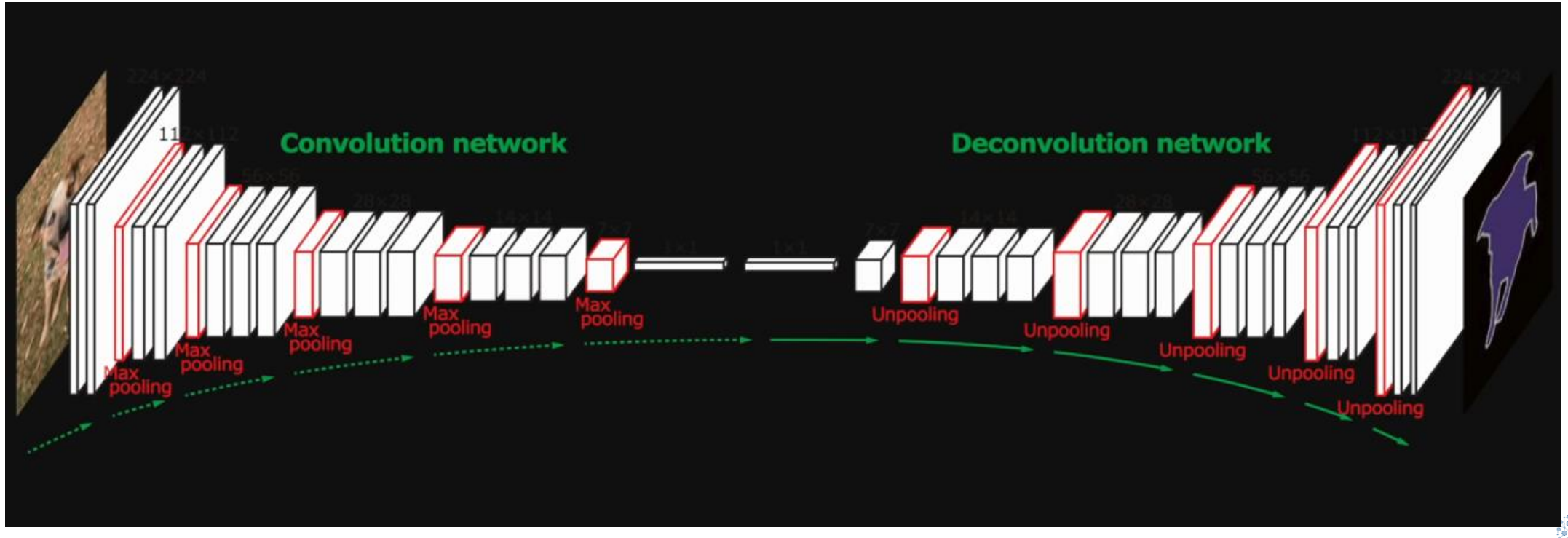
Results from DCGANs





GAN subcomponents idea ....

- استفاده از ایده‌های شبکه‌های دیگر در هر جزءِ شبکه GAN
- مثلا :



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2017 : Year of the GAN

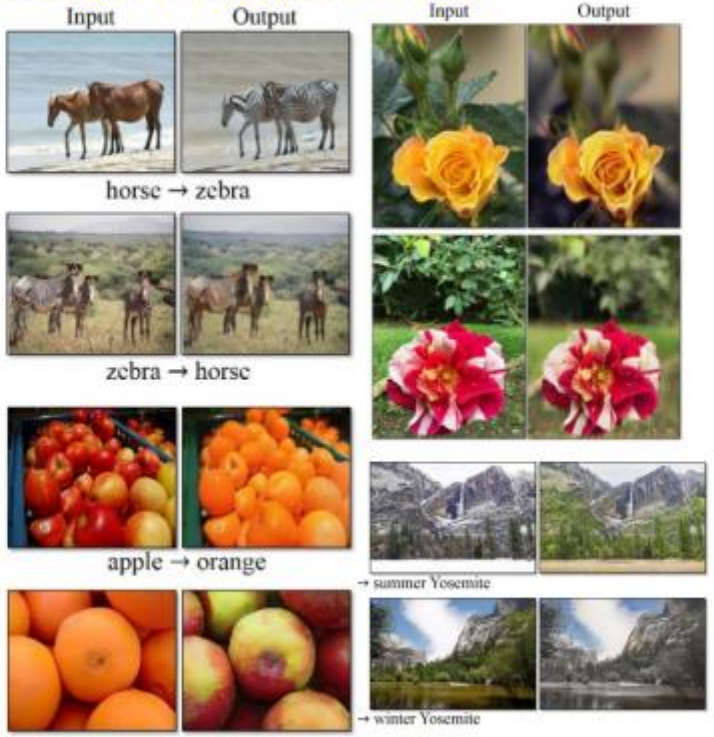
2017: Year of the GAN

Better training and generation

LSGAN. Mao et al. 2017.

BEGAN. Bertholet et al. 2017.

Source->Target domain transfer



CycleGAN. Zhu et al. 2017.

Text -> Image Synthesis

this small bird has a pink breast and crown, and black primaries and secondaries.

this magnificent fellow is almost all black with a red crest, and white cheek patch.

Reed et al. 2017.

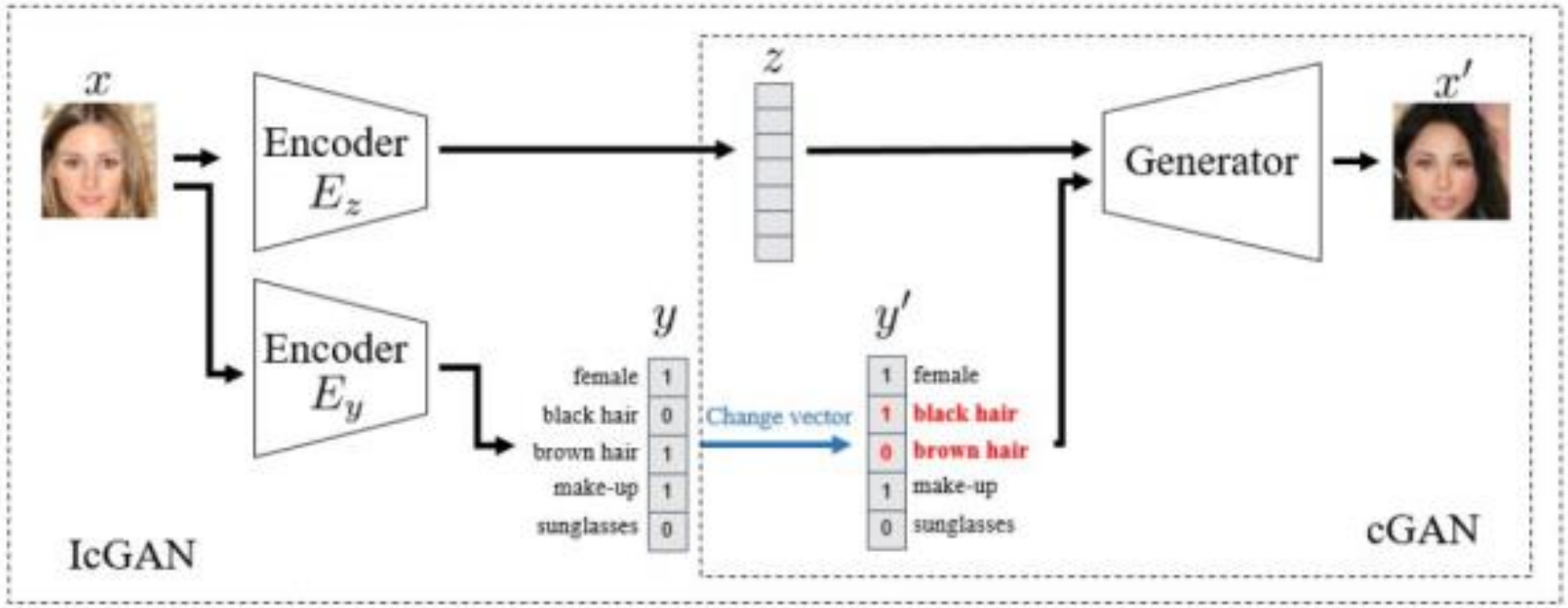
Many GAN applications

Pix2pix. Isola 2017. Many examples at https://phillipi.github.io/pix2pix/

iGAN

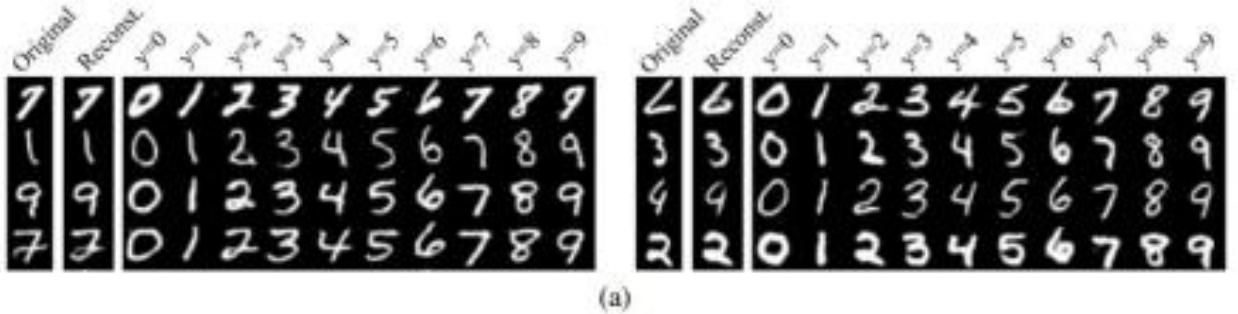
https://github.com/junyanz/iGAN

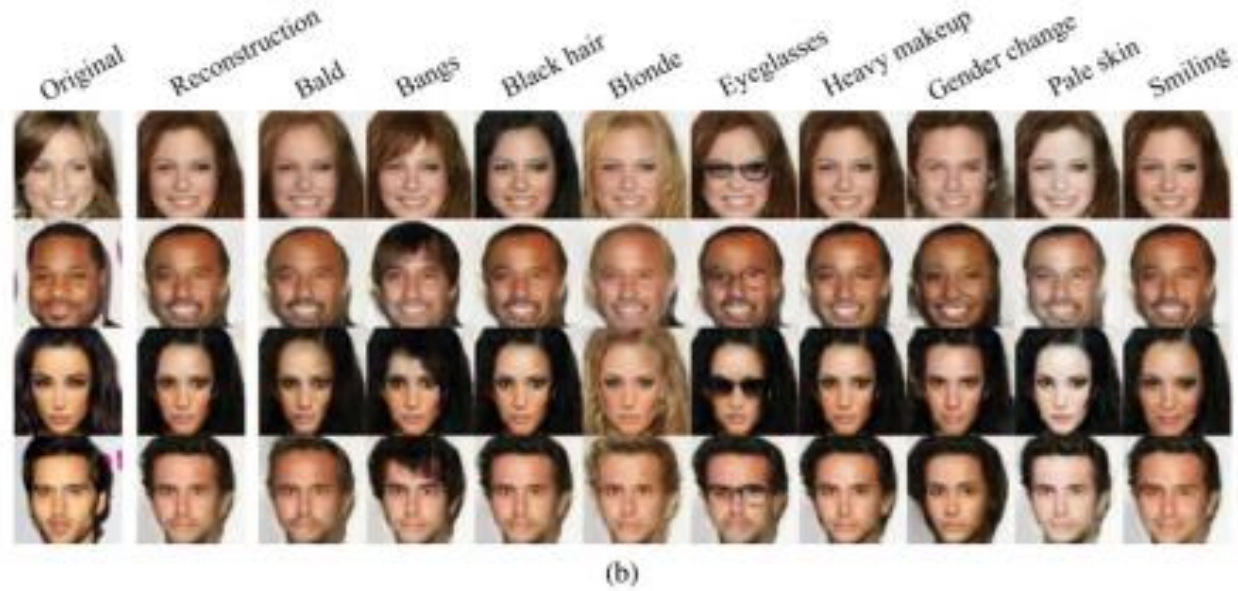
Invertible Conditional GANs for image editing



Perarnau et 2016

Invertible Conditional GANs for image editing

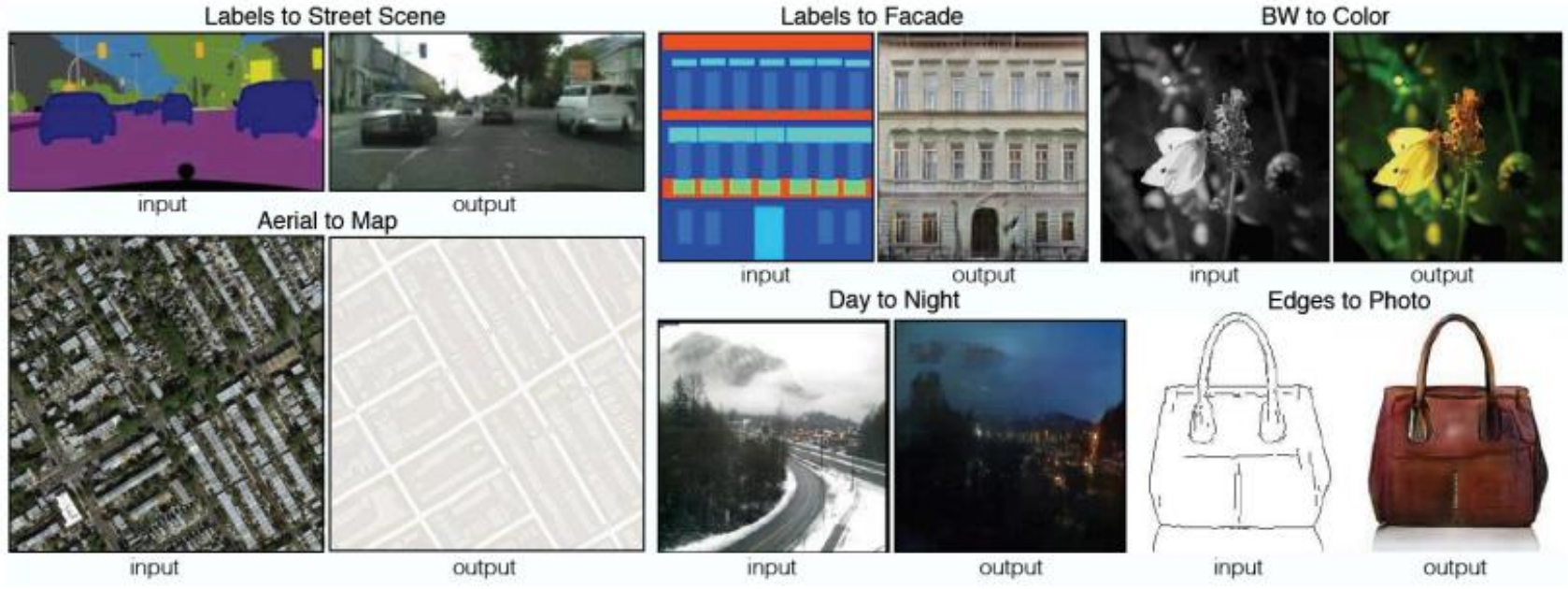




Perarnau et 2016

Image to Image translation

P. Isola, J. Zhu, T. Zhou, A. Efros “Image-to-image translation with conditional generative networks“, CVPR 2017

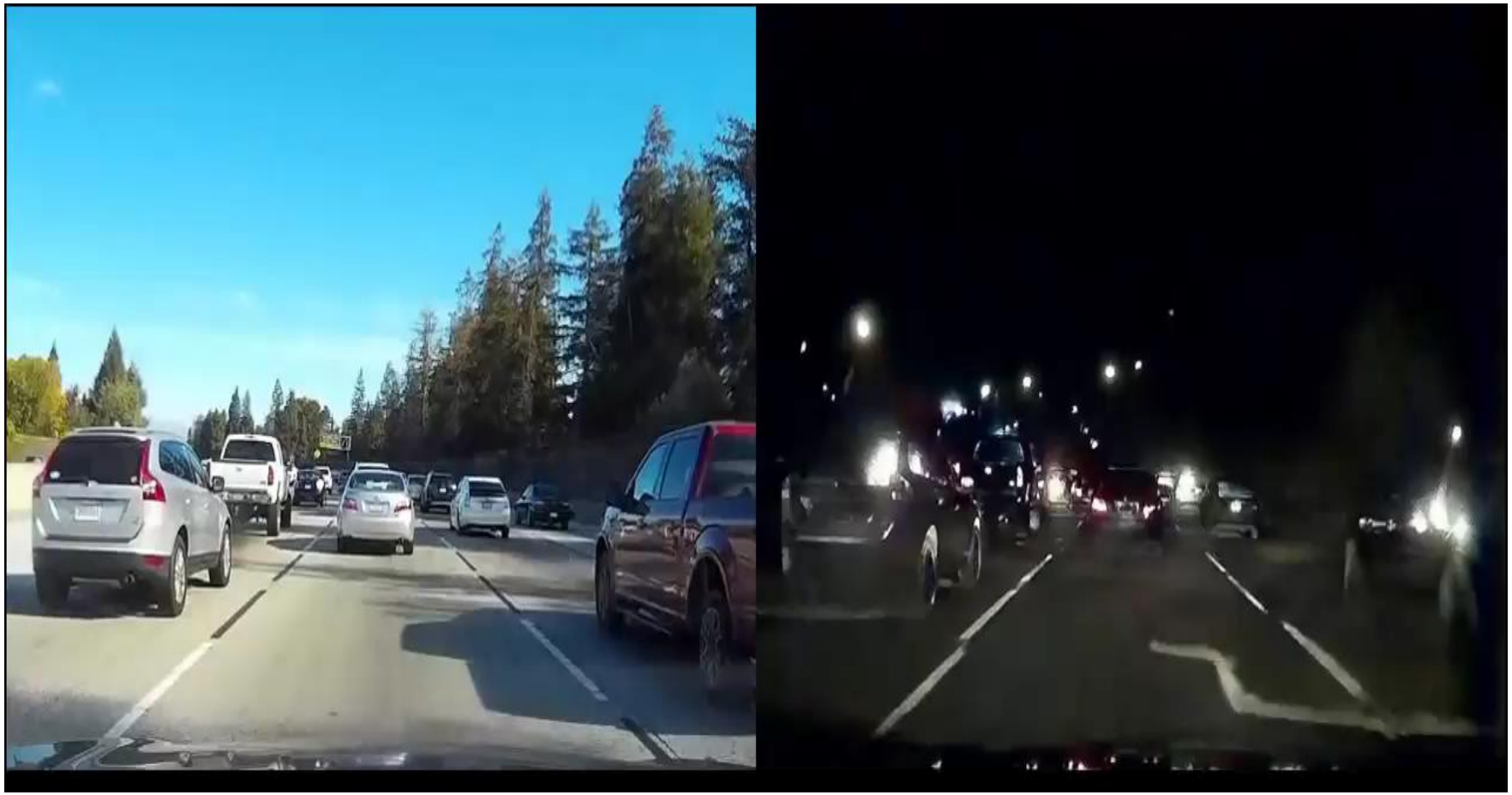


https://phillipi.github.io/pix2pix/

Image-to-Image Translation with CGAN

https://phillipi.github.io/pix2pix/

Image-to-Image Translation with CGAN



https://phillipi.github.io/pix2pix/

Image-to-Image Translation with CGAN

https://phillipi.github.io/pix2pix/

Image-to-Image Translation with CGAN

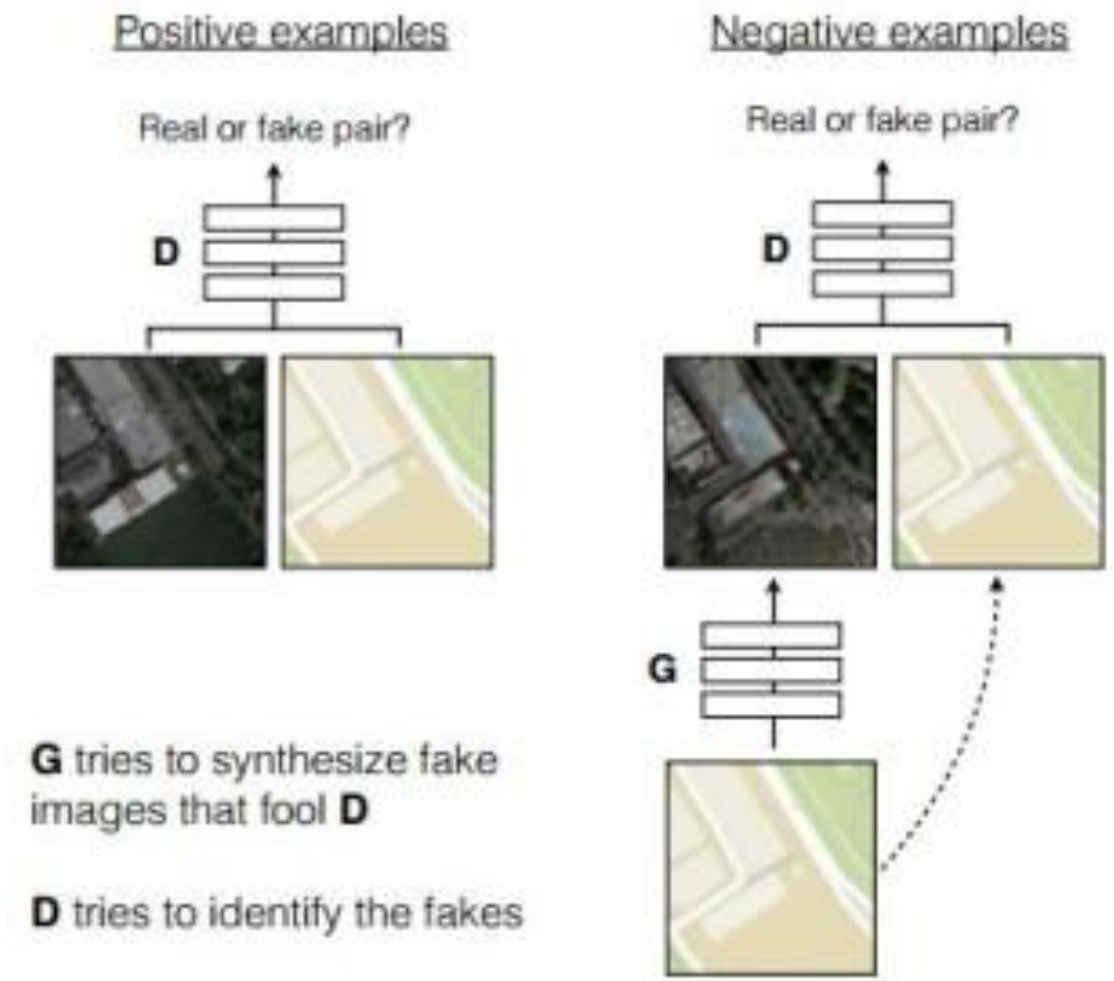
$$G: X \rightarrow Y$$

$$F: Y \rightarrow X$$

$$F(G(X)) \approx X$$

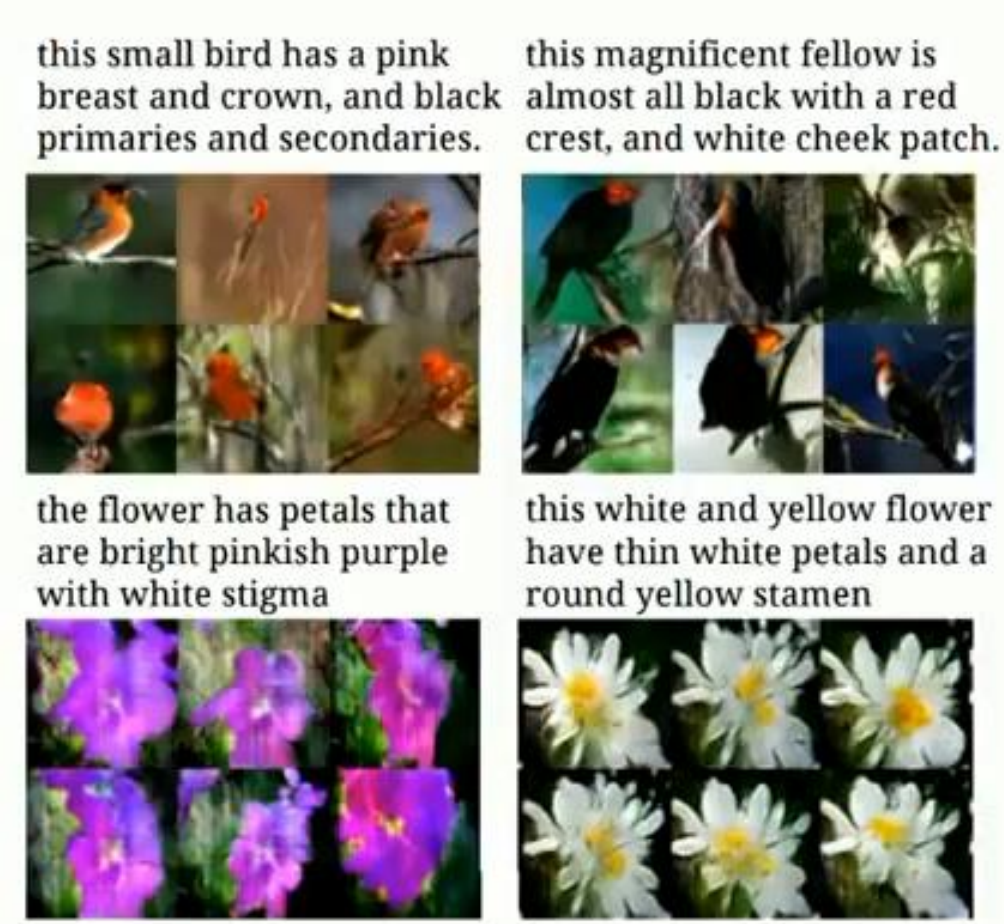
Cycle GAN

Image to Image translation



P. Isola,

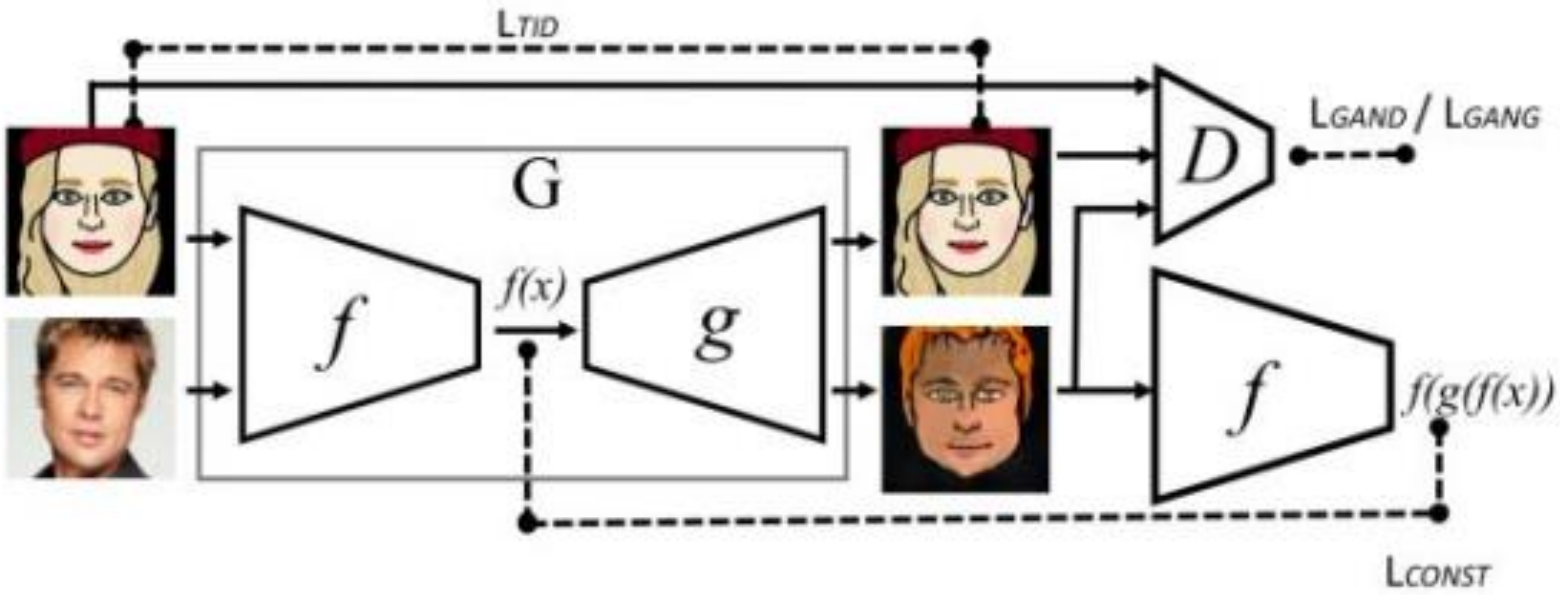
Text to Image



(Reed *et al.* 2016)

Zhang et al

Unsupervised cross-domain image generation

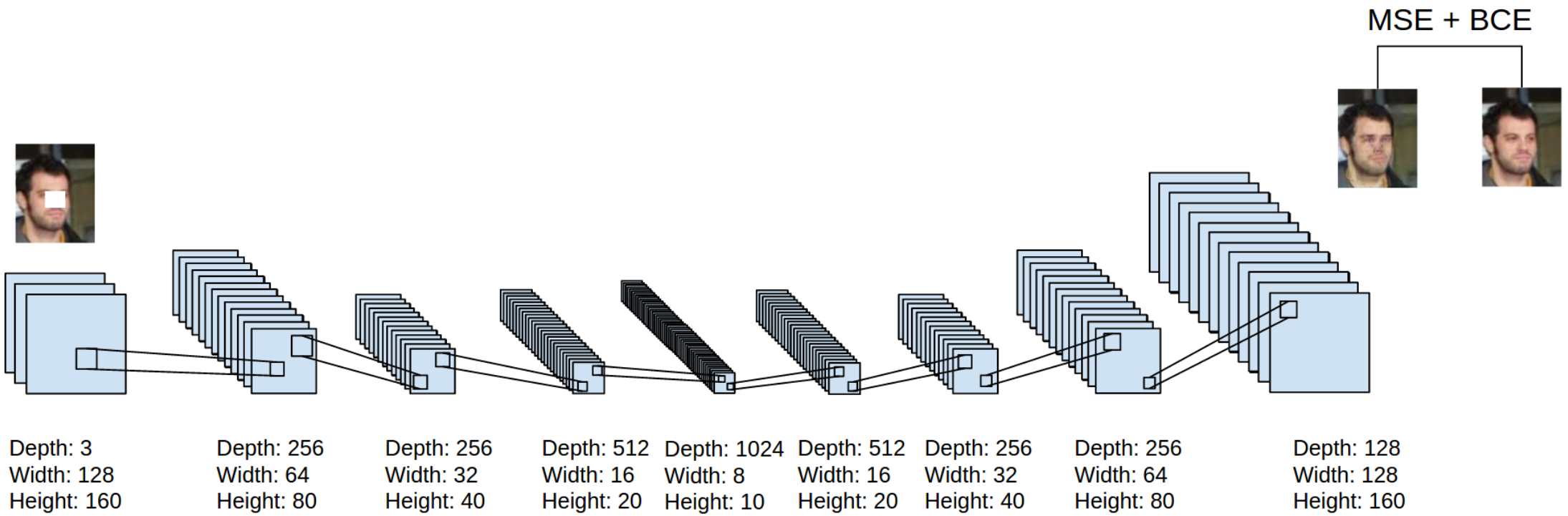


Taigman et al 2016

Unsupervised cross-domain image generation

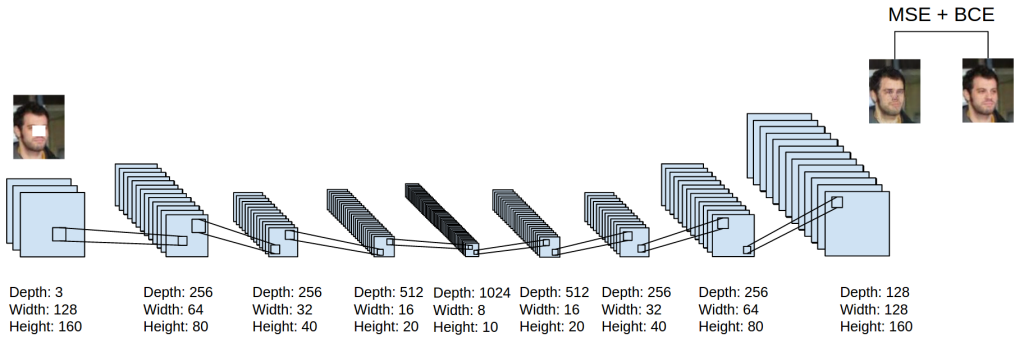
Taigman et al 2016

Denoising GAN



Denoising GAN

g_cost_d + enc_cost * X

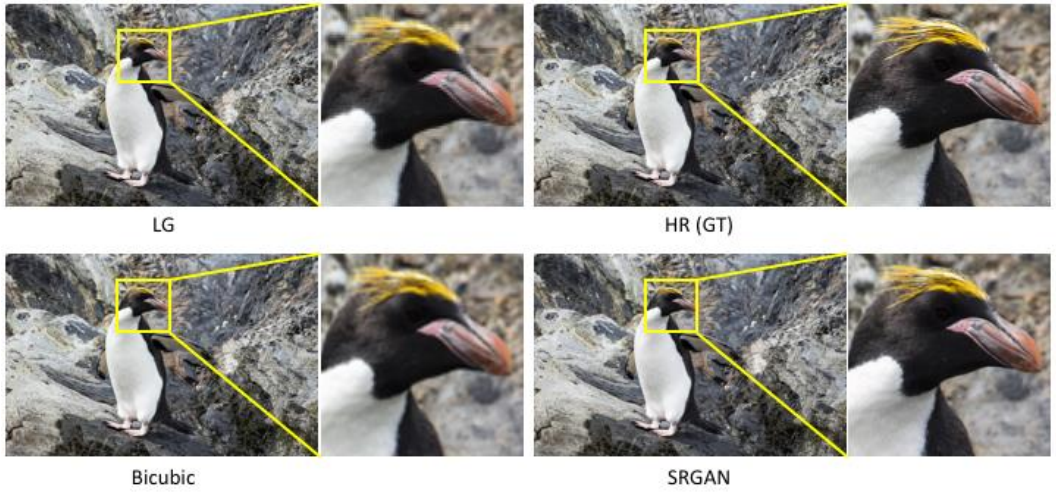


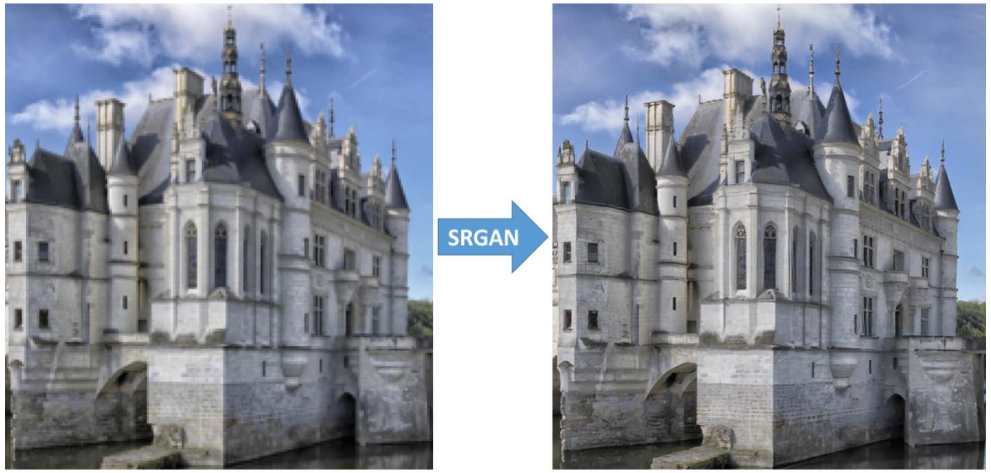

```
d_cost_real = binary_cross_entropy(p_real, T.ones(p_real.shape)).mean()
d_cost_gen = binary_cross_entropy(p_gen, T.zeros(p_gen.shape)).mean()

g_cost_d = binary_cross_entropy(p_gen, T.ones(p_gen.shape)).mean()
enc_cost = mse(source_flat, target_flat).mean()
```

https://www.cc.gatech.edu/~hays/7476/projects/Avery_Wenchen

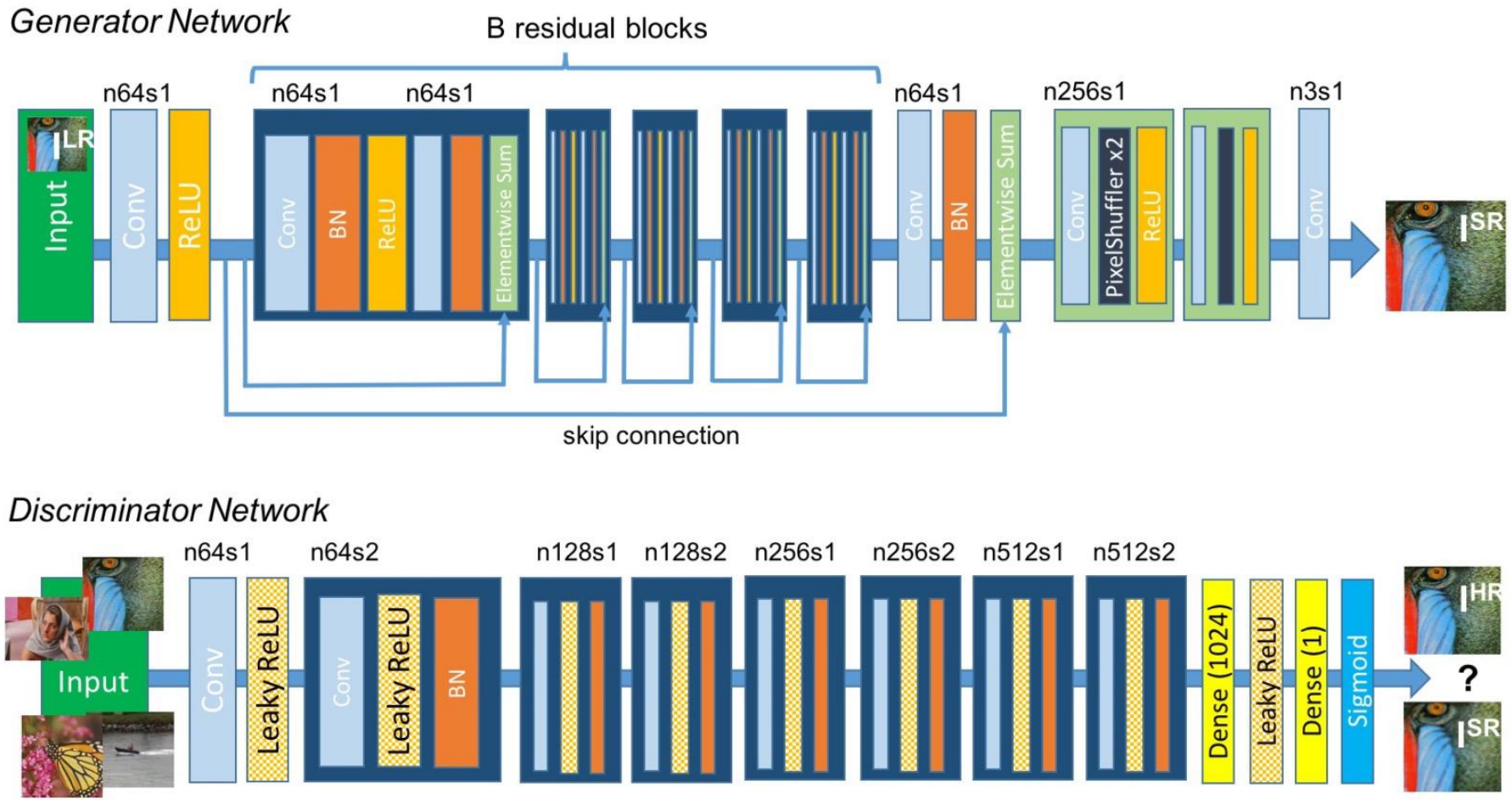
Super resolution (SRGAN)



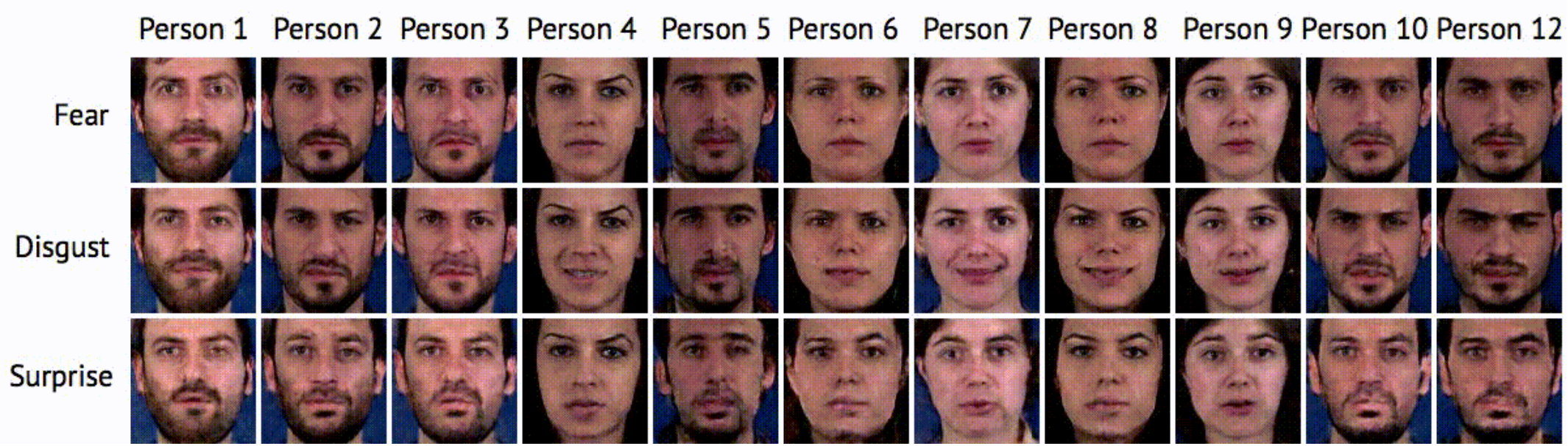


https://github.com/zsdonghao/SRGAN

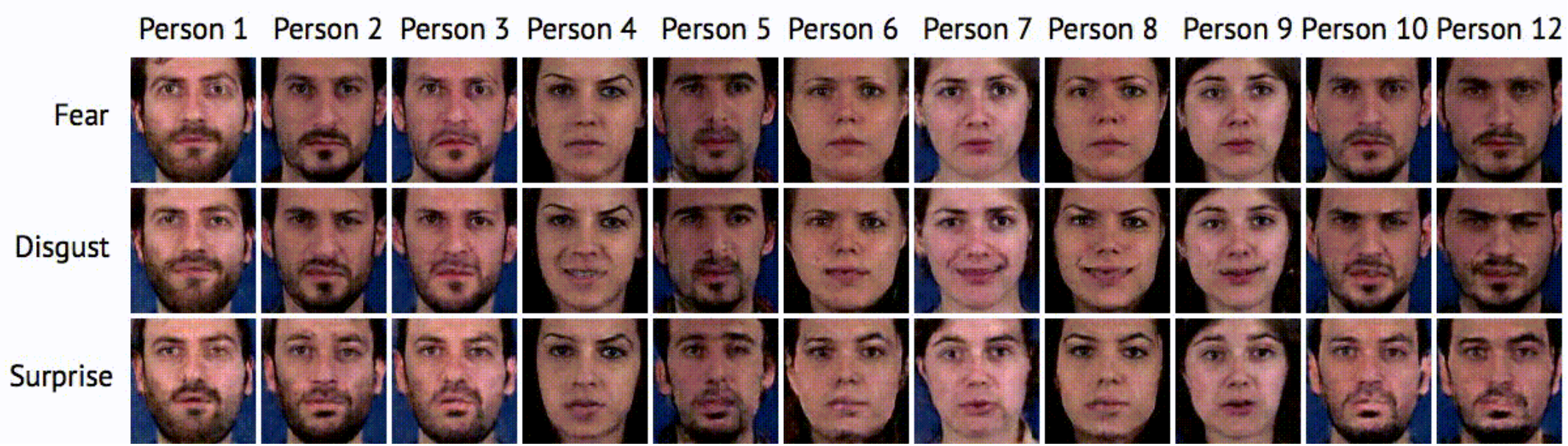
Super resolution (SRGAN)



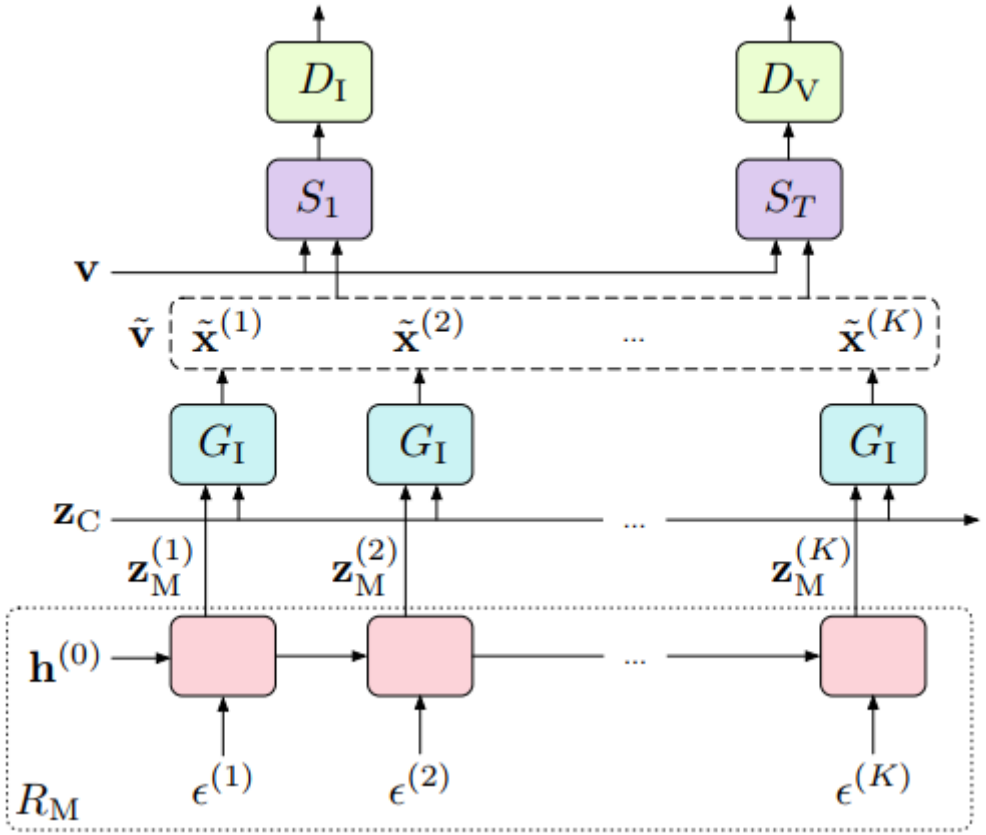
MoCoGAN: Decomposing Motion and Content for Video Generation



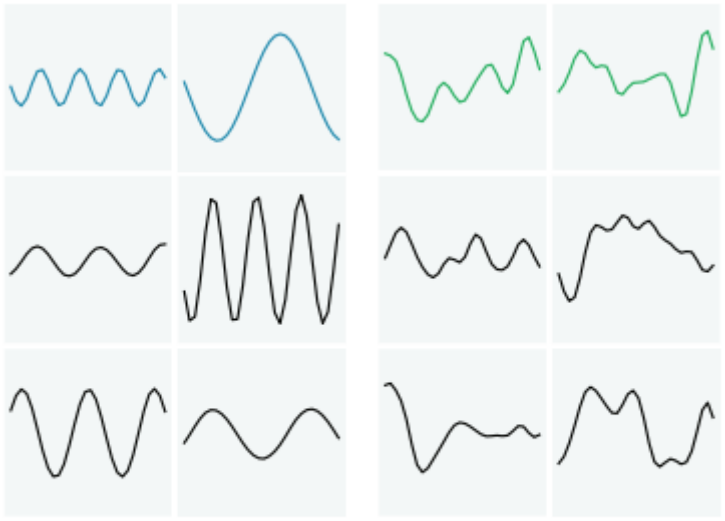
MoCoGAN: Decomposing Motion and Content for Video Generation



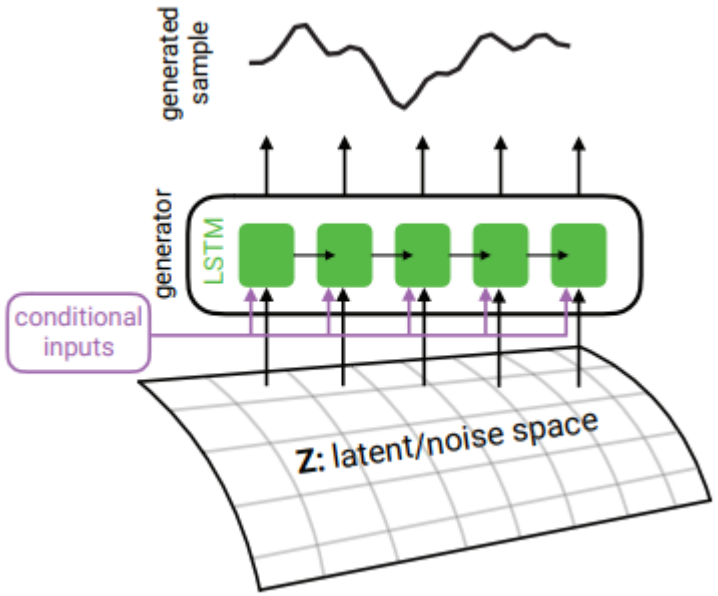
MoCoGAN: Decomposing Motion and Content for Video Generation

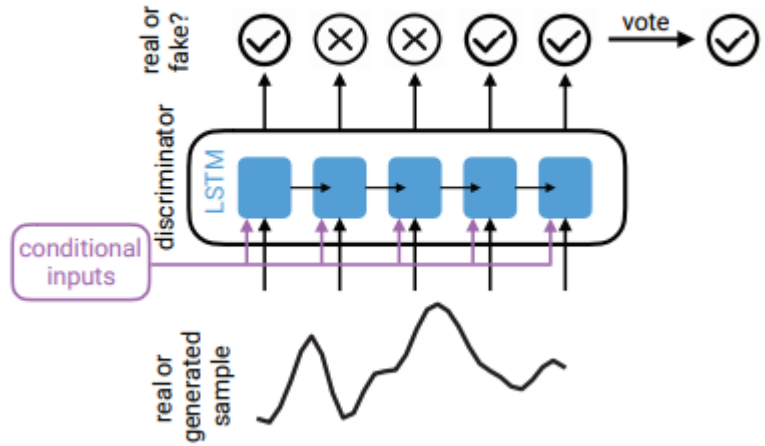


RECURRENT CONDITIONAL GANS (RCGAN)



Examples of real (coloured, top) and generated (black, lower two lines) samples.

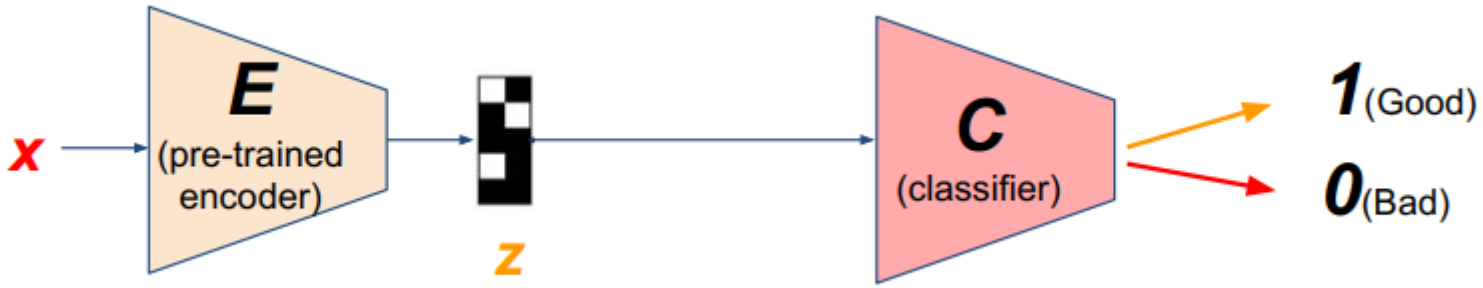




https://arxiv.org/pdf/1706.02633.pdf

Pre-trained unified features

- Pre-trained and shipped on mobile chip as default



Issues

- Finding equilibria harder than just optimizing losses
  - Local equilibrium points
- Non-convergence
  - Mode collapse

(Goodfellow 2016)

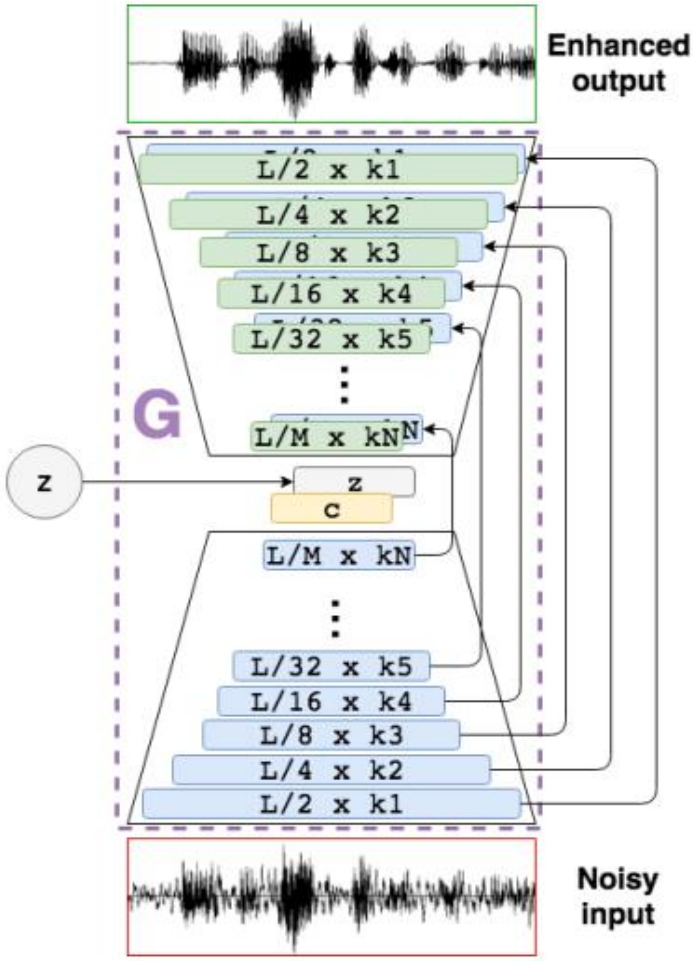
WGAN

Martin et al, Wasserstein GAN, 2017

- JSD → Earth Mover Distance(=Wasserstein-1 distance)
- Prevent the gradient vanishing by using weak distance metrics
- Provide the parsimonious training indicator.

http://tsong.me/blog/wasserstein-gan/

LSGAN



$$\min_G V_{\text{LSGAN}}(G) = \frac{1}{2}\,\mathbb{E}_{\mathbf{z}\sim p_{\mathbf{z}}(\mathbf{z}),\tilde{\mathbf{x}}\sim p_{\text{data}}(\tilde{\mathbf{x}})}[(D(G(\mathbf{z},\tilde{\mathbf{x}}),\tilde{\mathbf{x}})-1)^2]+ + \lambda\,\|G(\mathbf{z},\tilde{\mathbf{x}})-\mathbf{x}\|_1\,.$$

X. Mao, Q. Li, H. Xie, R. Lau, Z. Wang, "Least squares generative adversarial networks" 2016

Issues

- Finding equilibria harder than just optimizing losses
  - Local equilibrium points
- Non-convergence
  - Mode collapse

(Goodfellow 2016)

Conclusion

- GANs are generative models
  - that use supervised learning
  - to approximate an intractable cost function
- GANs can simulate
  - many cost functions
  - including the one used for maximum likelihood
- Finding Nash equilibria is an important open research problem
  - high-dimensional
  - Continuous
  - nonconvex games

(Goodfellow 2016)

Brief review of GAN

Don't work with an explicit density function
Take game-theoretic approach: learn to generate from training distribution through 2-player game

Pros:

- Beautiful, state-of-the-art samples!

Cons:

- Trickier / more unstable to train
- Can't solve inference queries such as p(x), p(z|x)

Active areas of research:

- Better loss functions, more stable training (Wasserstein GAN, LSGAN, many others)
- Conditional GANs, GANs for all kinds of applications

Fei-Fei Li Stanford 2017

HAMIM

Thank you!

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