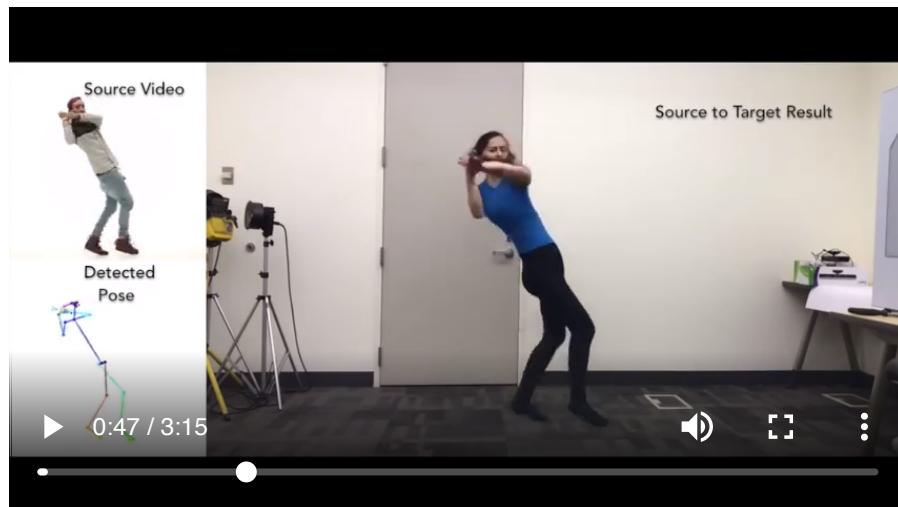


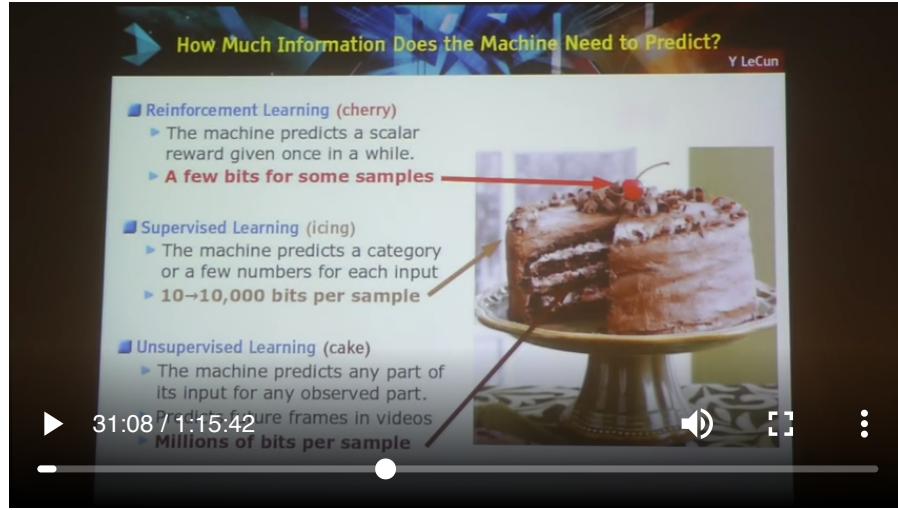
GAN と VAE

- 実習:信長の夢
-



-
- Yann LeCun (現 FAIR 所長) said in [CMU RI Seminar: Yann LeCun: The Next Frontier in AI: Unsupervised Learning, November 18, 2016](#)

42分20秒頃から **敵対学習は本当にクールなアイデアだ。機械学習の分野で20年来で一番クールだ** 'An adversarial training is a really really really cool idea. It's like the coolest idea in machine learning last twenty years.'



敵対訓練

- ざっくりいうと
 - 2人ゼロサムゲーム 古典的なミニマックス戦略
 - プレーヤーは双方ともニューラルネットワーク
- GAN は詳細高密度な画像を生成可能
- GAN はデータの密度関数を学習
- 少数の教師ありデータから、インタラクティブに種々の事例を生成可能 → さまざまな発展の可能性、プライバシー、製品開発、検査、



(Ledig et al 2016)

from Goodfellow(2016)NIPS tutorial

Image to Image Translation



(Isola et al 2016)

(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

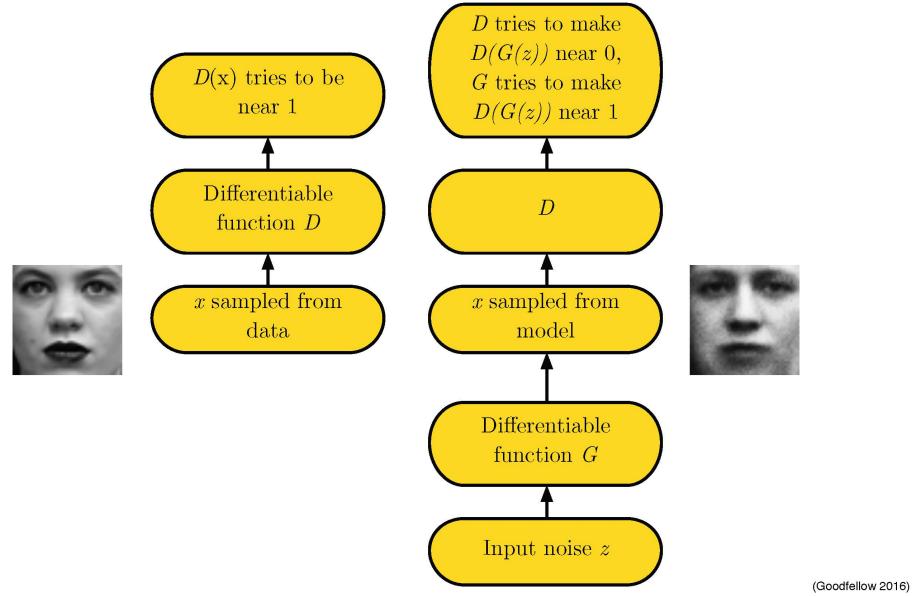
GANs

- Use a latent code
- Asymptotically consistent (unlike variational methods)
- No Markov chains needed
- Often regarded as producing the best samples
 - No good way to quantify this

(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

Adversarial Nets Framework

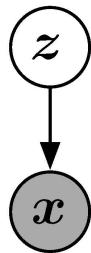


(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

Generator Network

$$\mathbf{x} = G(\mathbf{z}; \boldsymbol{\theta}^{(G)})$$



- Must be differentiable
- No invertibility requirement
- Trainable for any size of \mathbf{z}
- Some guarantees require \mathbf{z} to have higher dimension than \mathbf{x}
- **Can make \mathbf{x} conditionally Gaussian given \mathbf{z} but need not do so**

from

(Goodfellow 2016)

Goodfellow(2016)NIPS tutorial

Minimax Game

$$J^{(D)} = -\frac{1}{2} \mathbb{E}_{\mathbf{x} \sim p_{\text{data}}} \log D(\mathbf{x}) - \frac{1}{2} \mathbb{E}_{\mathbf{z}} \log (1 - D(G(\mathbf{z})))$$
$$J^{(G)} = -J^{(D)}$$

- Equilibrium is a saddle point of the discriminator loss
- Resembles Jensen-Shannon divergence
- Generator minimizes the log-probability of the discriminator being correct

(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

Non-Saturating Game

$$J^{(D)} = -\frac{1}{2} \mathbb{E}_{\mathbf{x} \sim p_{\text{data}}} \log D(\mathbf{x}) - \frac{1}{2} \mathbb{E}_{\mathbf{z}} \log (1 - D(G(\mathbf{z})))$$
$$J^{(G)} = -\frac{1}{2} \mathbb{E}_{\mathbf{z}} \log D(G(\mathbf{z}))$$

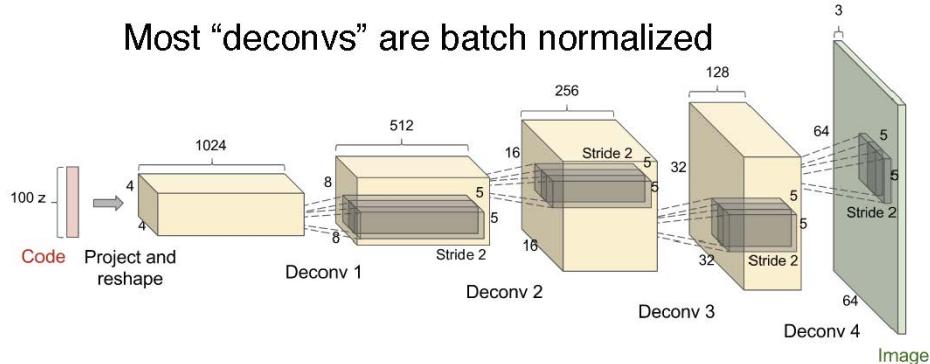
- Equilibrium no longer describable with a single loss
- Generator maximizes the log-probability of the discriminator being mistaken
- Heuristically motivated; generator can still learn even when discriminator successfully rejects all generator samples

(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

DCGAN Architecture

Most “deconv”s are batch normalized

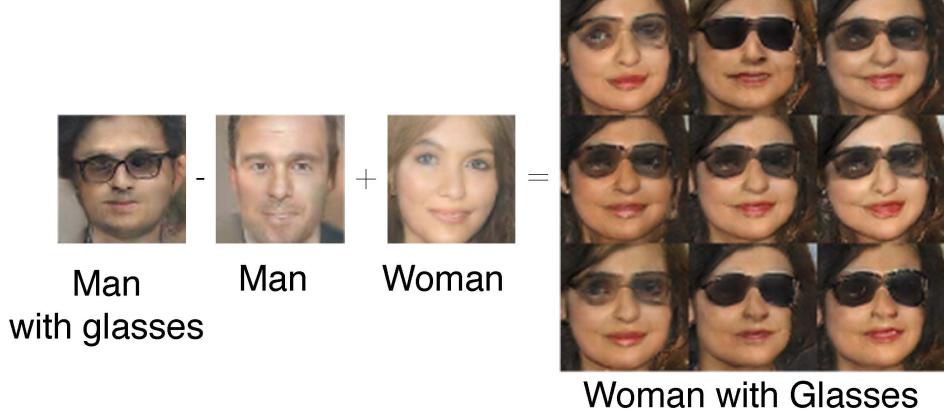


(Radford et al 2015)

(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

Vector Space Arithmetic



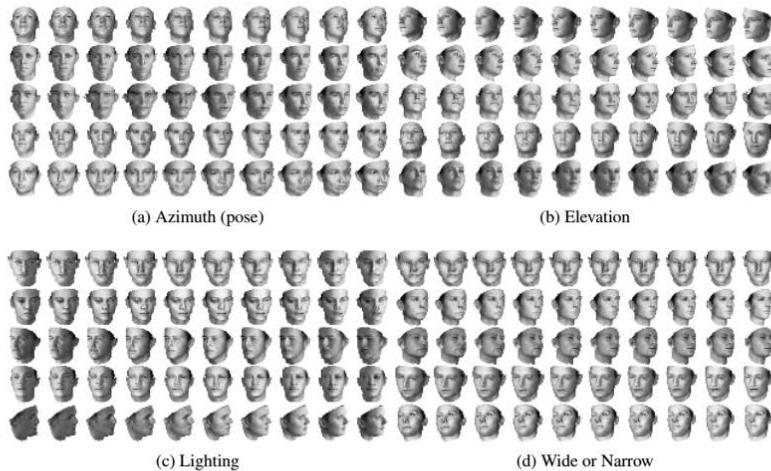
from

(Radford et al, 2015)

(Goodfellow 2016)

Goodfellow(2016)NIPS tutorial

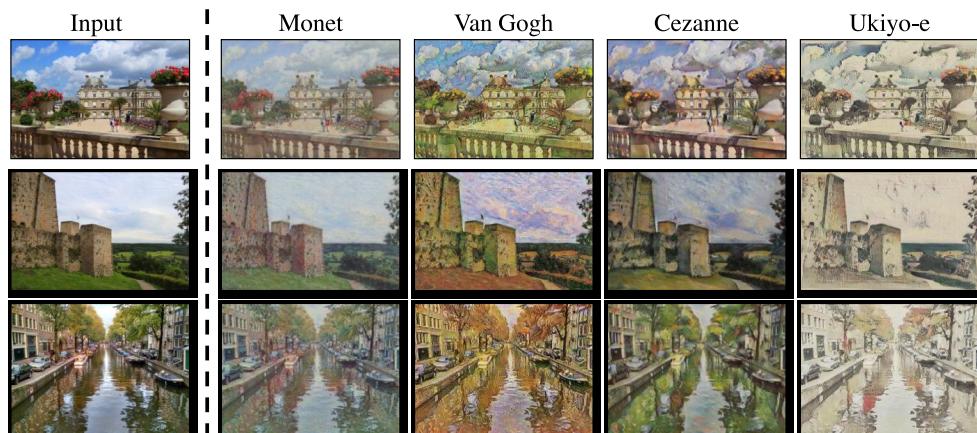
Learning interpretable latent codes / controlling the generation process

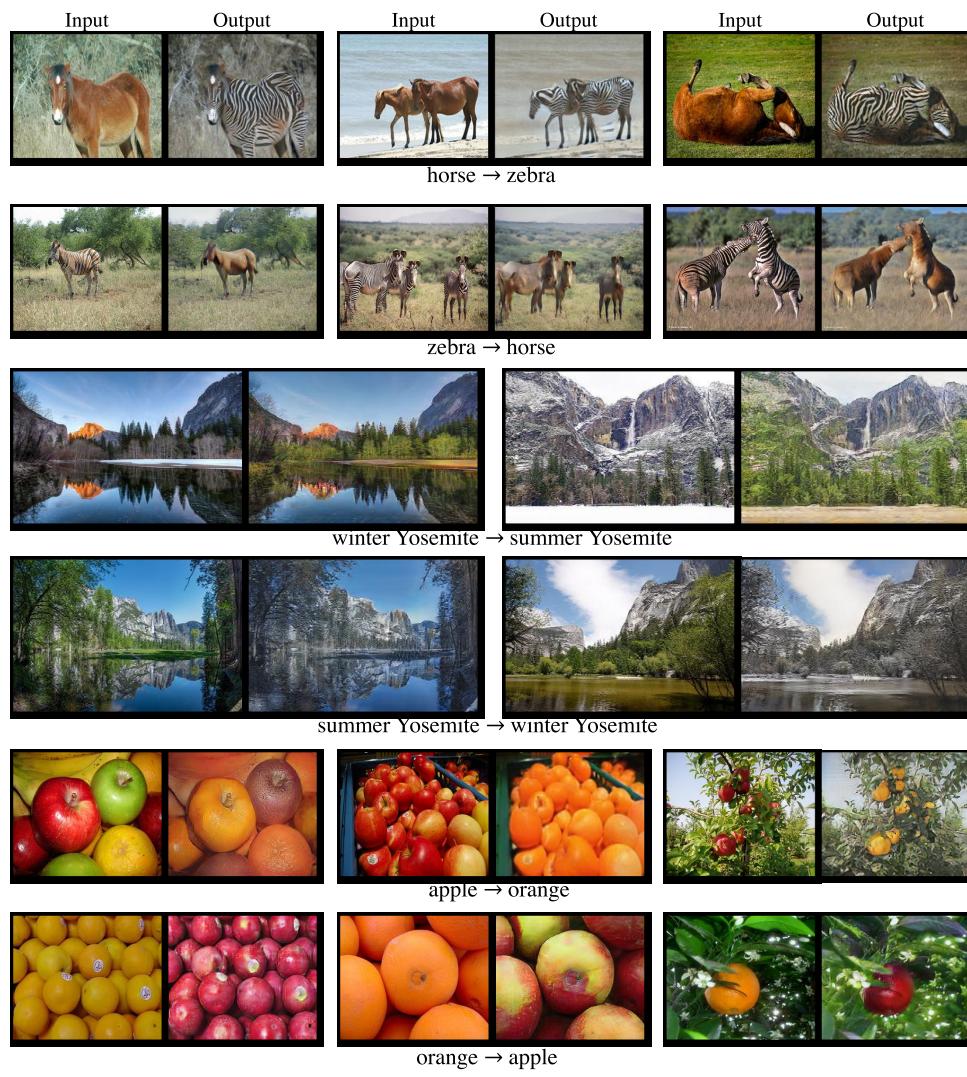


InfoGAN (Chen et al 2016)

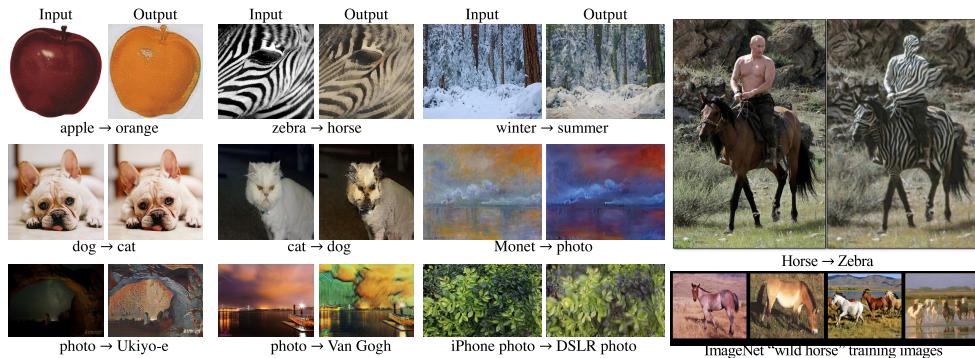
(Goodfellow 2016)

from Goodfellow(2016)NIPS tutorial

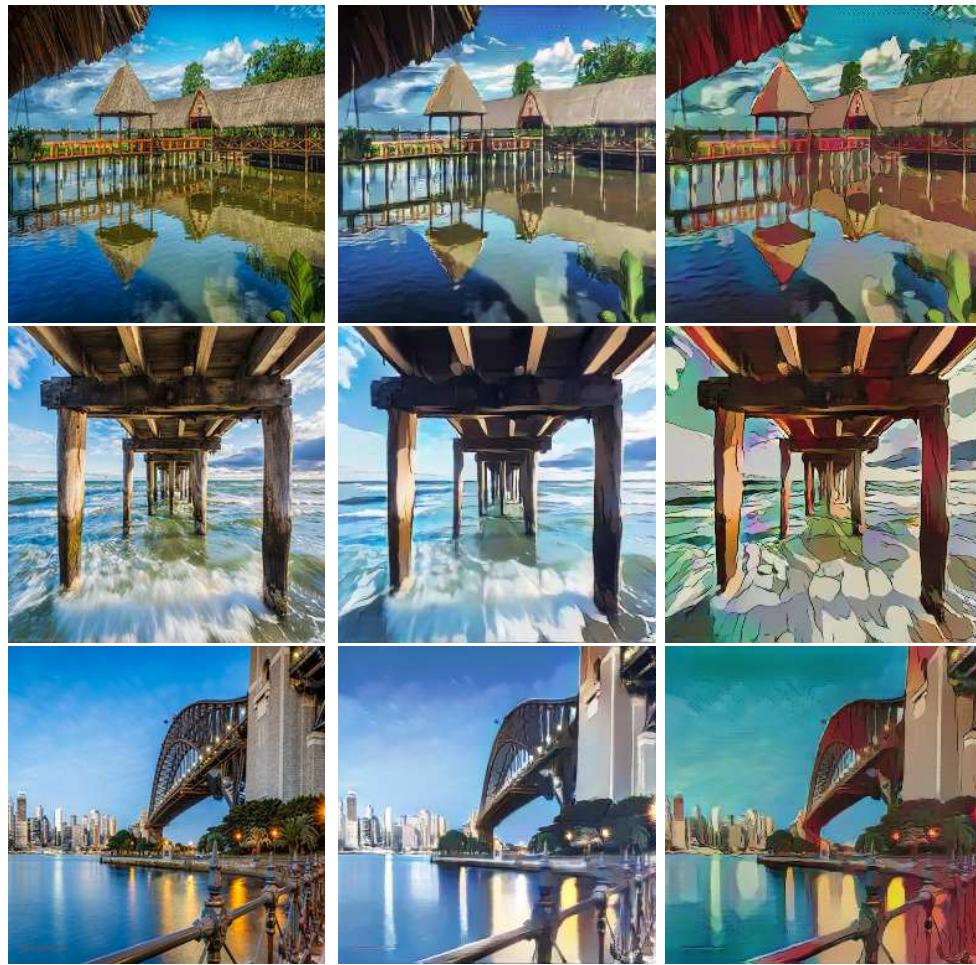




from Zhu et. al.(2017) Cycle GAN



from Zhu et. al.(2017) Cycle GAN



(a) input photo

(b) Shinkai style
from Chen et. al.(2018) CartoonGAN

(c) Hayao style

Cross-domain retrieval

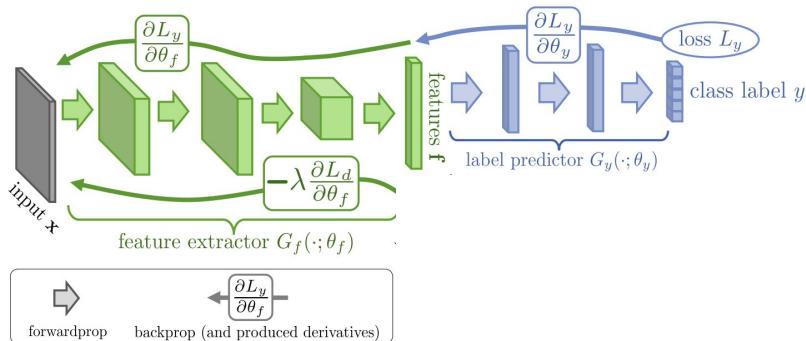
Query	Real	Clip art	Spatial text	Sketches	Descriptions
city			cabinet door wall cabinet sink floor		Everything you could need in one dinner, right? This kitchen has all of the regular fixtures you'd expect, like a sink, cabinets, and a stove. Moreover, there are some more unique elements, but they don't really fit in with the rest of the space.
skyline			sky window building window		A structure in which people live or work, especially one made of concrete and steel. It's a very tall building, and it's surrounded by other buildings in the city.
castle			sky castle wall road		The building appeared to be a castle, with the towers and walls. Inside the stone air was filled with smoke. There were all the allowed structures, and the castle was dressed in white and red colors. I could tell this was a medieval castle.
road			sky mountain crossroad		This defines the word "road". It is a road with high mountains on both sides. The road goes through the mountains, and there are many trees and rocks along the way.
There is a path running through a dense forest, surrounded by trees and bushes, and it's used to navigate through the area and explore the world. The path is well-maintained and leads to the entrance of the forest.			trees trees dirt_track		I love to hike in the mountains. I like to walk on the trail and sometimes it's hard to see where to go. I like to look at the trees and the sound of birds chirping.

1. Castrejon & Aytar et al. "Learning Aligned Cross-Modal Representations from Weakly Aligned Data". In CVPR, 2016.

Trends: Domain Adaptation / Unsupervised Alignment

from Reed et.al., (2017)

Unsupervised domain transfer for classification

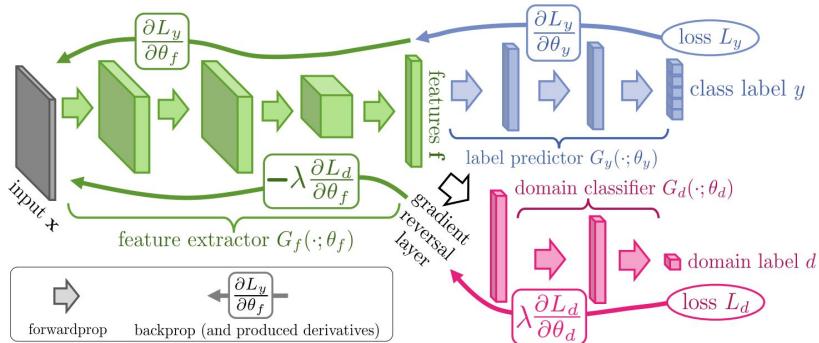


1. Ganin et al. "Domain-Adversarial Training of Neural Networks", JMLR 2016

Trends: Domain Adaptation / Unsupervised Alignment

from Reed et.al., (2017)

Unsupervised domain transfer for classification

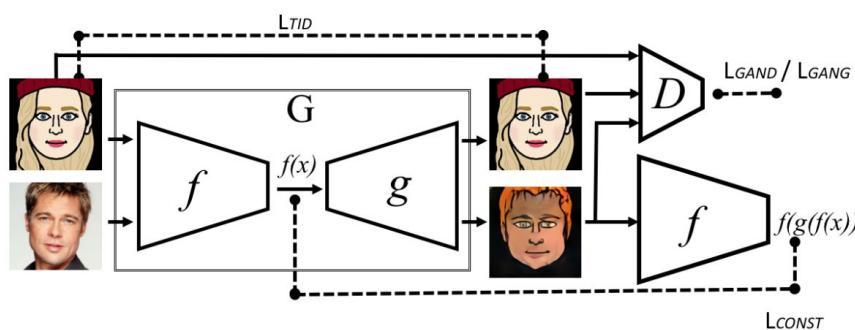


1. Ganin et al. "Domain-Adversarial Training of Neural Networks", JMLR 2016

Trends: Domain Adaptation / Unsupervised Alignment

from Reed et.al., (2017)

Unsupervised cross-domain image generation

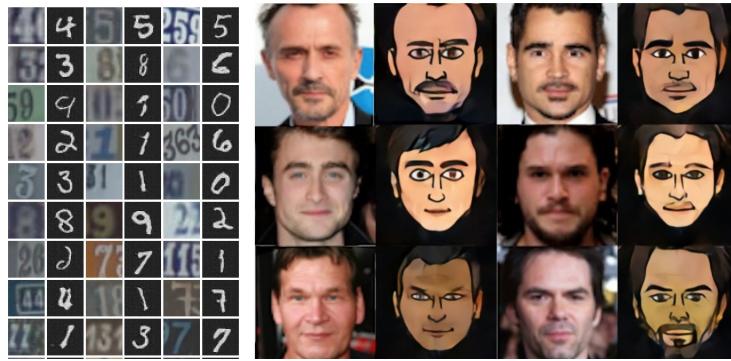


1. Taigmen et al. "Unsupervised Cross-domain image generation". In ICLR 2017.

Trends: Domain Adaptation / Unsupervised Alignment

from Reed et.al., (2017)

Unsupervised cross-domain image generation

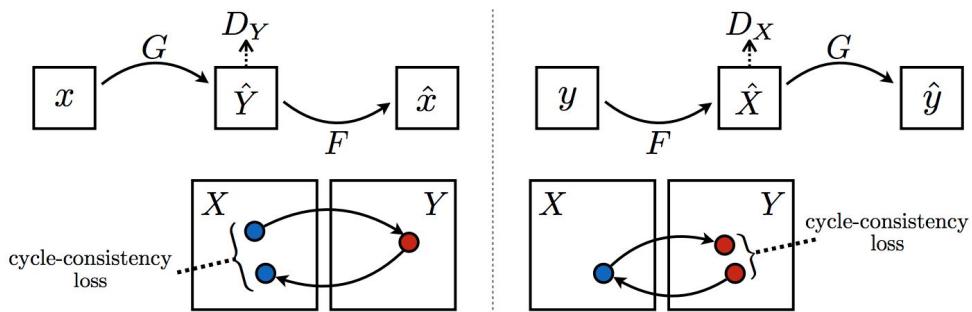


1. Taigmen et al. "Unsupervised Cross-domain image generation". In ICLR 2017.

Trends: Domain Adaptation / Unsupervised Alignment

from Reed et.al., (2017)

Cycle-consistency loss



1. Zhu et al. "Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks". In ICCV, 2017.

Trends: Domain Adaptation / Unsupervised Alignment

from Reed et.al., (2017)

- Collection of Interactive Machine Learning Examples

Machine Learning Examples: Seedbank

To see end-to-end examples of the interactive machine learning analyses that Colaboratory makes possible, check out the [Seedbank](#) project.

A few featured examples:

- [Neural Style Transfer](#): Use deep learning to transfer style between images.
- [EZ NSynth](#): Synthesize audio with WaveNet auto-encoders.
- [Fashion MNIST with Keras and TPUs](#): Classify fashion-related images with deep learning.
- [DeepDream](#): Produce DeepDream images from your own photos.
- [Convolutional VAE](#): Create a generative model of handwritten digits.
- [Convolutional VAE](#)
- [deep dream](#)
- [deep dream on google drive](#)

