Jan. 8th, 2021

Class 3: Model

Exploring AI and Neural Nets in Design

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Irving Innovation Fellow 2020 - 2021

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Lab for Design Technologies, Harvard University
Currently at Certain Measures

Acknowledgements

1. DCGAN Tutorial by Nathan Inkawhich https://github.com/inkawhich
2. Creative Machine Learning for Design by Dr. Danhaive and Prof. Mueller
3. Many many referenced in the slides

Housekeeping & Troubleshooting

1. Did you upload your dataset to your GDrive?

2. Deciding your project and making your own Dataset:

What's your progress?

GO TO: https://bit.ly/contacts-gsdai

Data	Model	Project (Workshop)
1. Collection	1. Choosing a Model	Latent Space Exploration #1 **Interpolation Animation**
2. Curation	2. Training a Model	Latent Space Exploration #2 **Interpolated Grid**
3. Processing		Latent Space Exploration #3 **Vector Arithmetic**

Data	Model	Project
1. Collection	1. Choosing a Model **DCGAN**	Latent Space Exploration #1 **Interpolation Animation**
2. Curation	2. Training a Model **Workshop**	Latent Space Exploration #2 **Interpolated Grid**
3. Processing		Latent Space Exploration #3 **Vector Arithmetic**

1.1 Workshop

Google CoLab

DCGAN Training Set-up

1.2 DCGAN

What is GAN?

Code Walk-through

Different Types of GAN

1.3 Deep Learning Models

Types of Machine Learning

Unsupervised Learning vs.Supervised Learning

GAN vs. CNN vs. RNN

Troubleshooting Session (30 min)

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Unsupervised Learning vs.Supervised Learning

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Troubleshooting Session (30 min)

GO TO: Google Drive > jterm > class > class 03 >

Workshop 3 Outline

Copy dcgan_train_128.ipynb

1.1

Workshop

Google CoLab

DCGAN Training Set-up

1.2

DCGAN

What is GAN? DCGAN?

Code Walk-through

Different Types of GAN

1.3

Deep Learning Models

Types of Machine Learning

Unsupervised Learning vs.Supervised Learning

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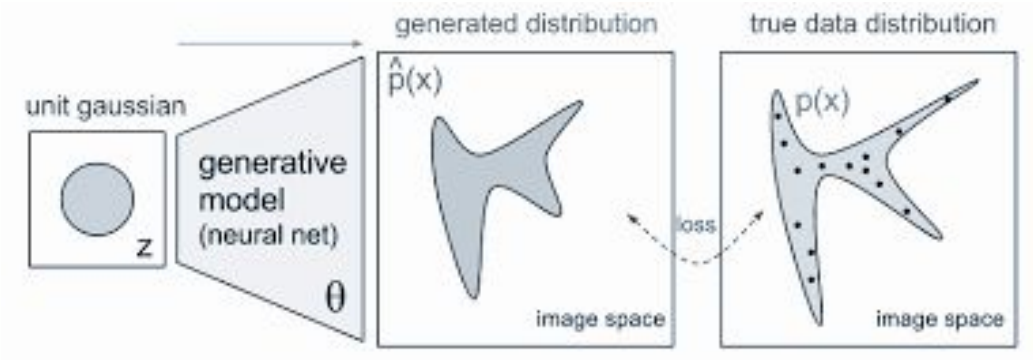
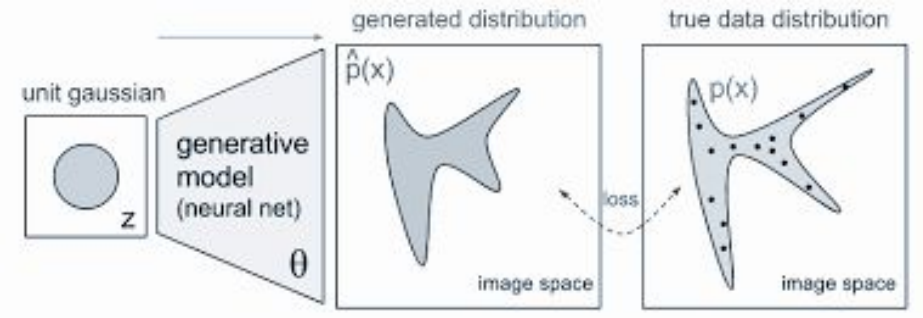
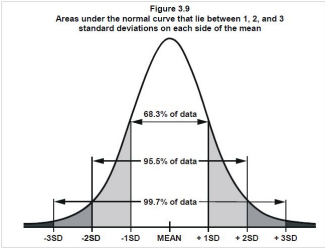
Troubleshooting Session (30 min)

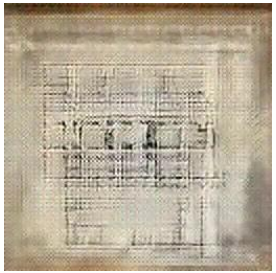
What is GAN?


generated distribution
true data distribution
unit gaussian
z
generative
model
(neural net)
θ
p̂(x)
p(x)
loss
image space
image space

What is GAN?

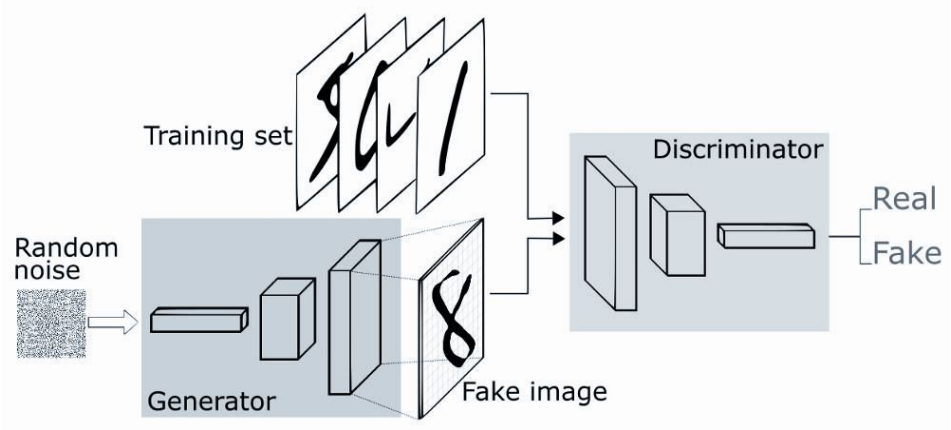






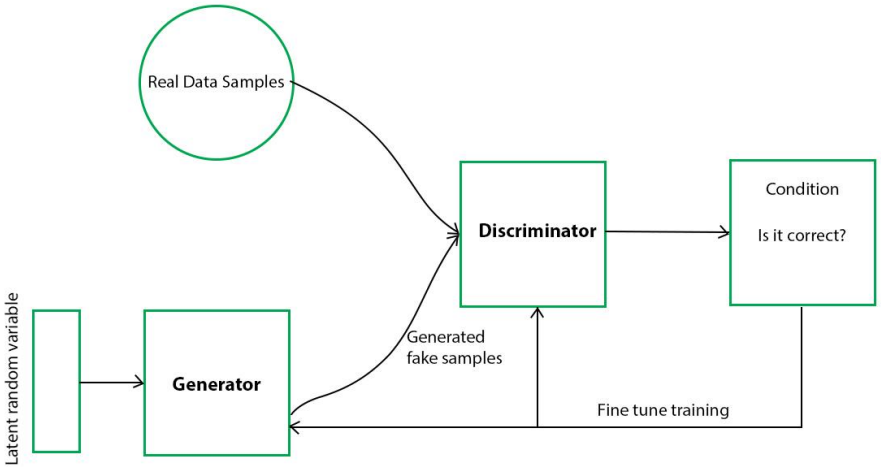
Generative Modeling

What is GAN?



DCGAN Architecture (Generator)
From Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

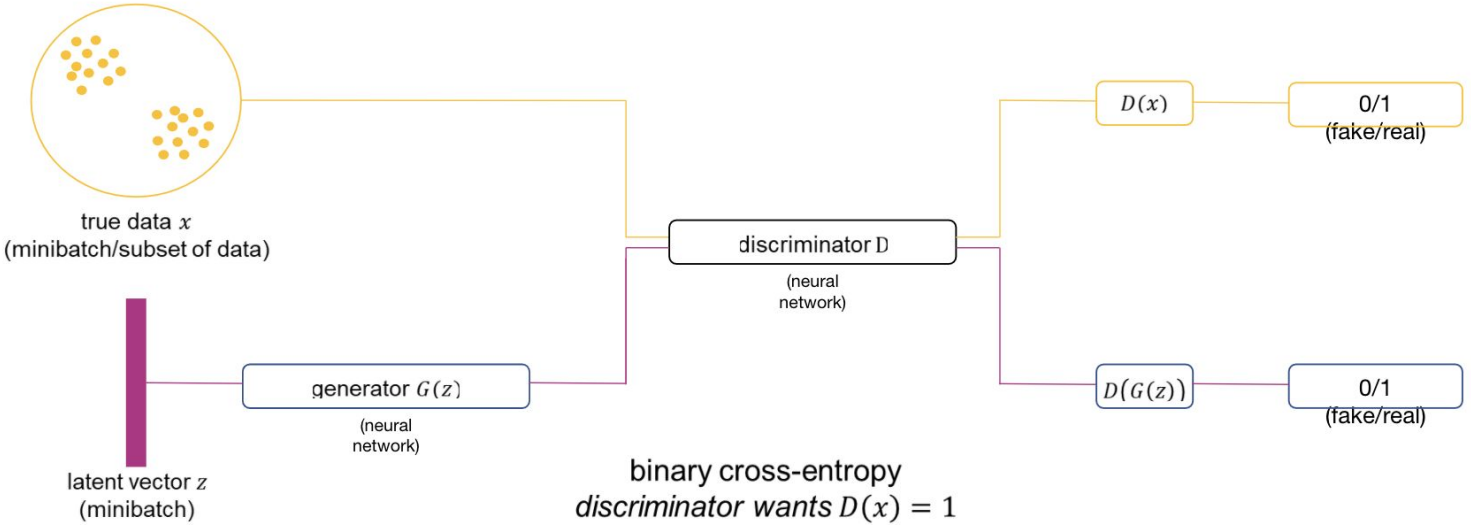
What is GAN?



DCGAN Architecture (Generator)
From Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

What is GAN?

Generative Adversarial Networks



binary cross-entropy

discriminator wants $D(x) = 1$

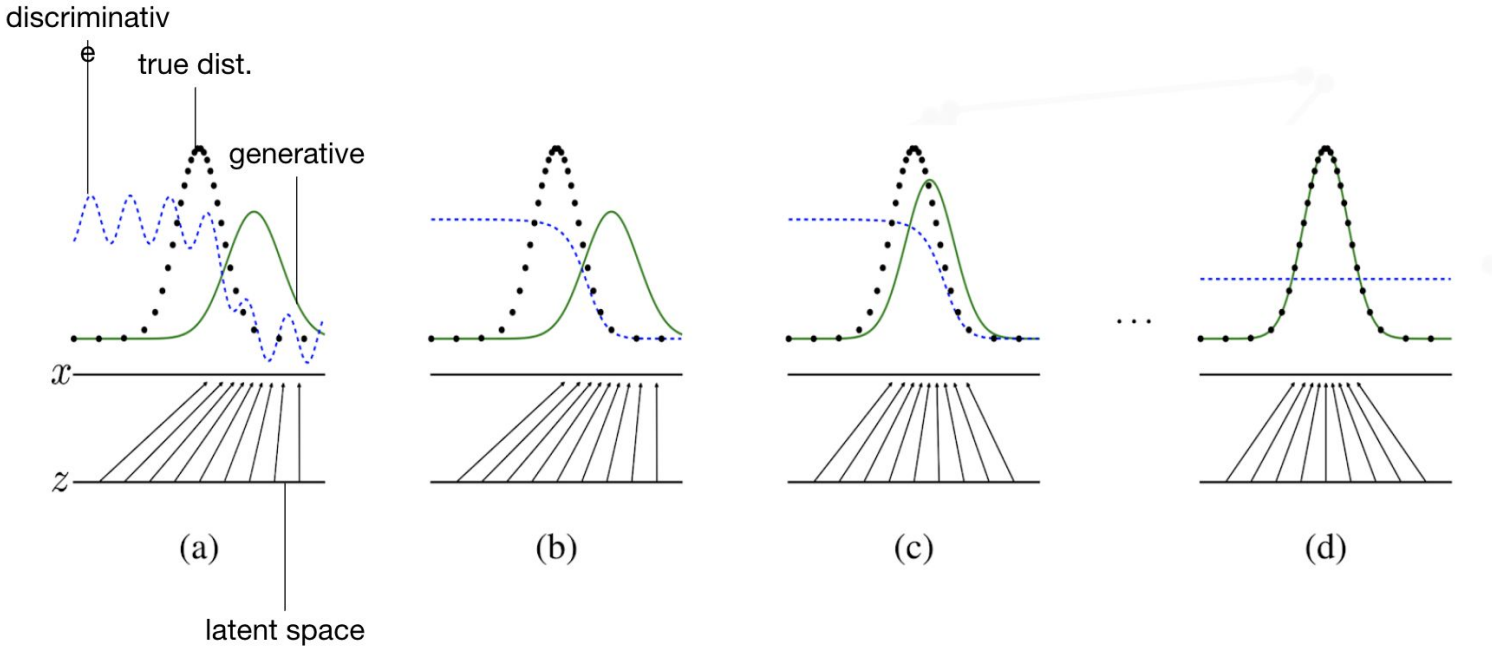
$$\min_G \max_D V(D,G) = \mathbb{E}_{\boldsymbol{x}\sim p_{\text{data}}(\boldsymbol{x})}[\log D(\boldsymbol{x})] + \mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}[\log(1 - D(G(\boldsymbol{z})))]$$

discriminator want $D(G(z)) = 0$

generator wants $D(G(z)) = 1$ *(=fool the disc.)*

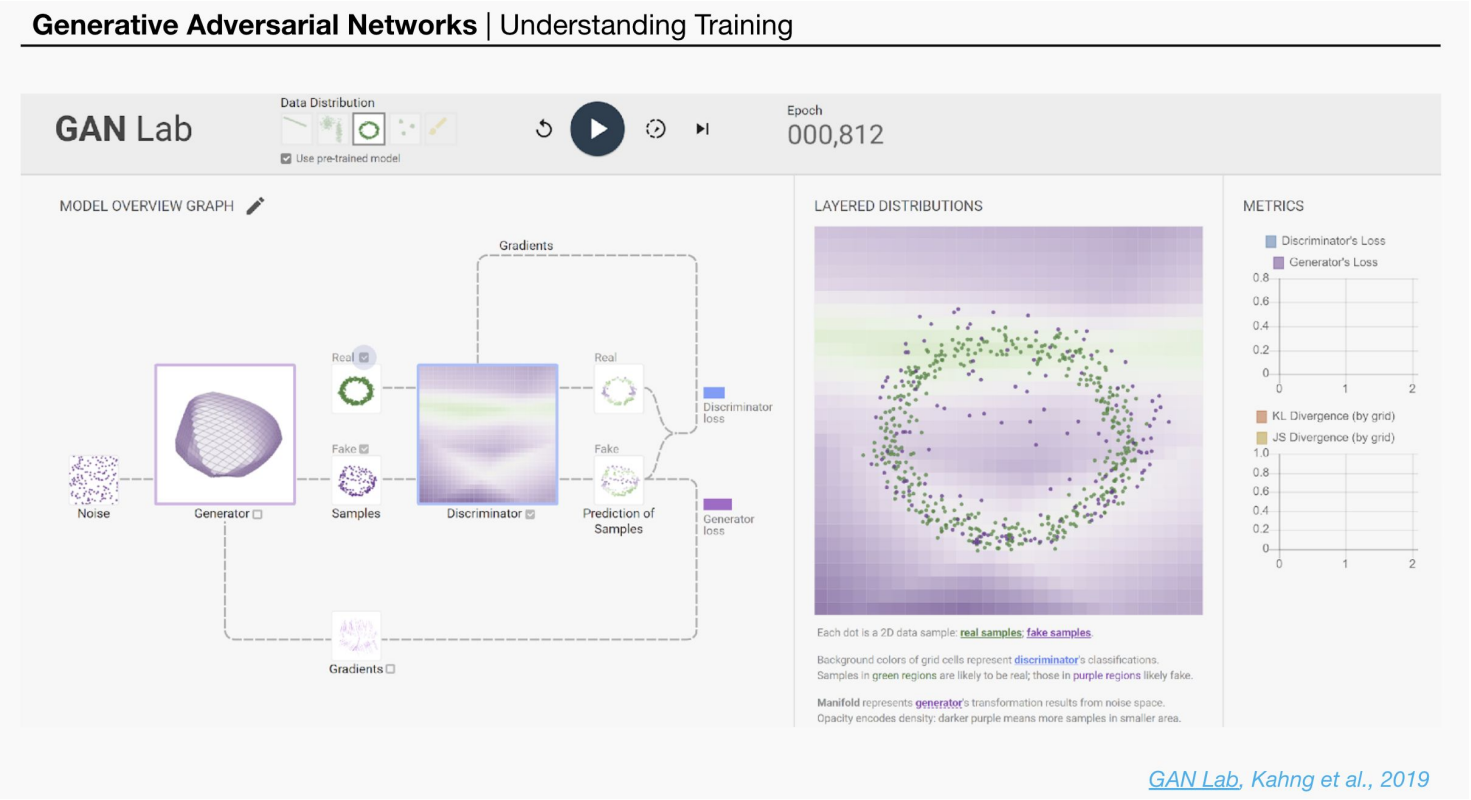
What is GAN?

Generative Adversarial Networks | Convergence



Goodfellow et al., 2014

What is GAN?

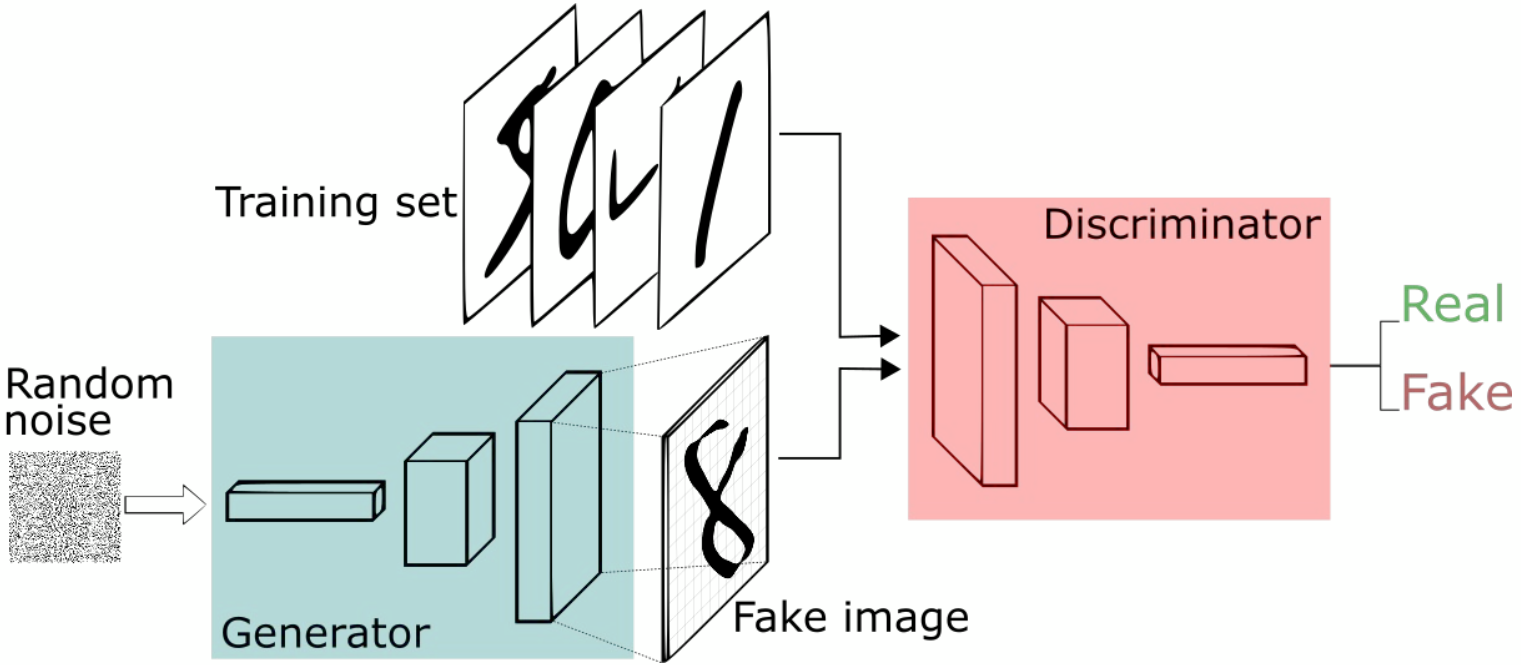


GAN Lab, Kahng et al., 2019

https://poloclub.github.io/ganlab/

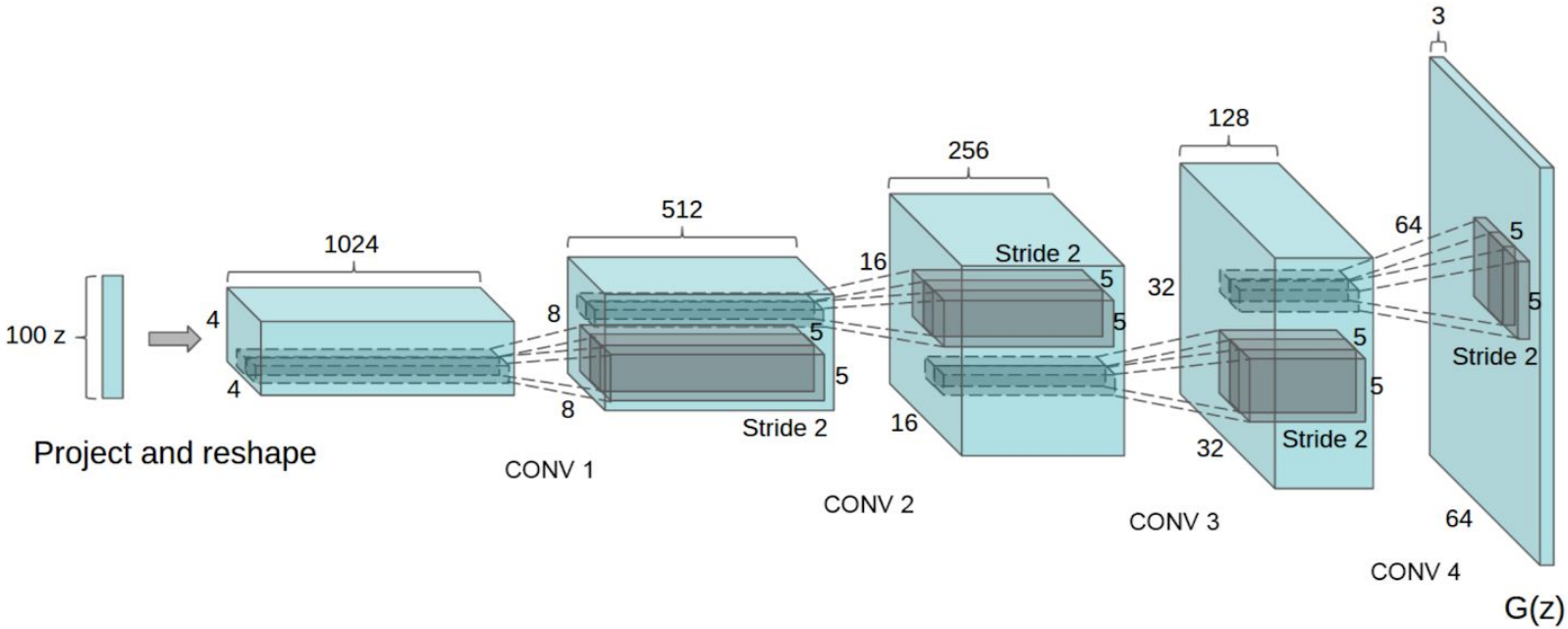
Creative Machine Learning for Design by Dr. Danhaive and Prof. Mueller

What is DCGAN?



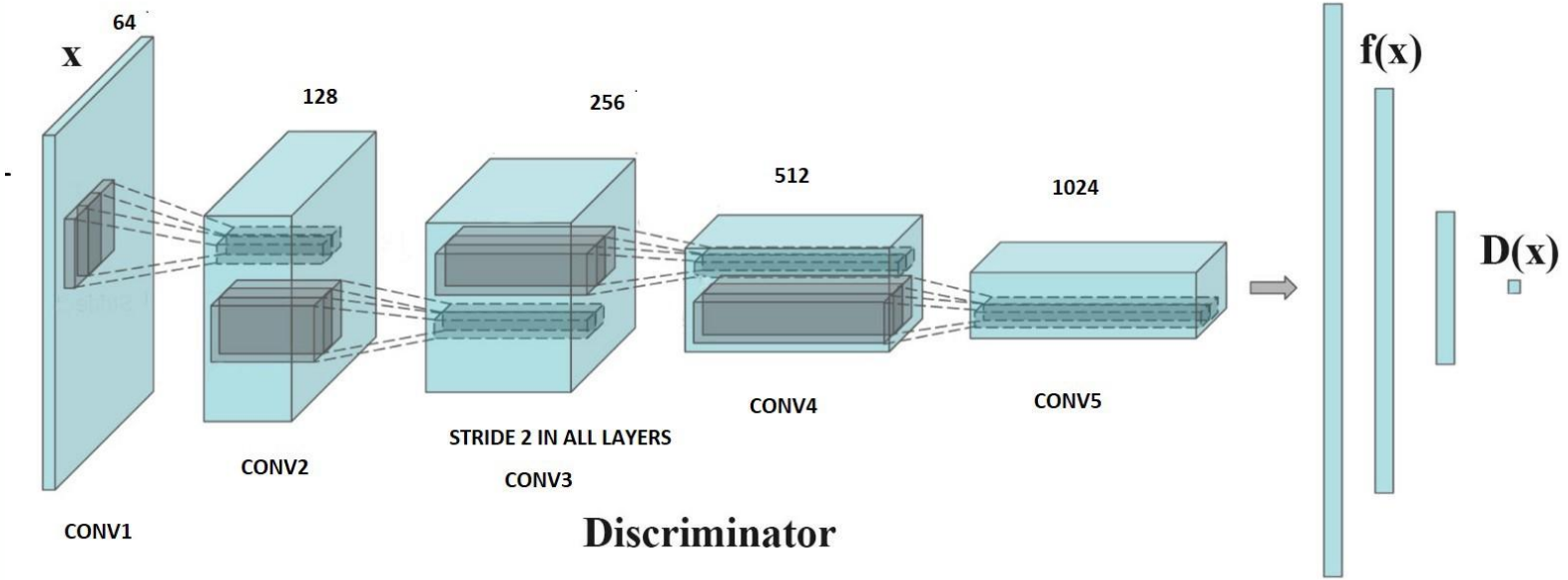
DCGAN Architecture
From Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

What is DCGAN? (Generator)



DCGAN Architecture (Generator)
From [Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks]

What is DCGAN? (Discriminator)



DCGAN Architecture (Discriminator)
From Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

Back to the Code: dcgan_train_128.ipynb

1.1

Workshop

Google CoLab

DCGAN Training Set-up

1.2

DCGAN

What is GAN?

Code Walk-through

Different Types of GAN

1.3

Deep Learning Models

Types of Machine Learning

Convolution?

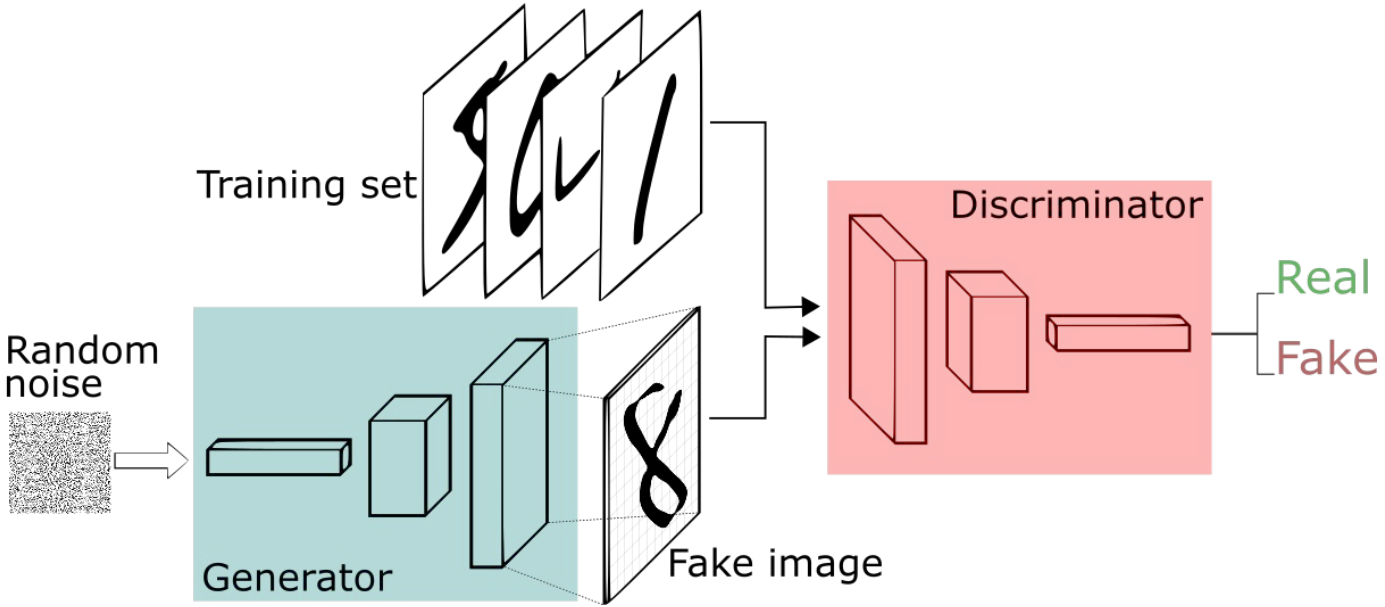
Unsupervised Learning
vs.Supervised Learning

Troubleshooting Session (30 min)

What is Machine Learning?

Machine Learning, Explained
from FAIR (Facebook AI Research)

What is DCGAN?



DCGAN Architecture
From Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

What is DCGAN?

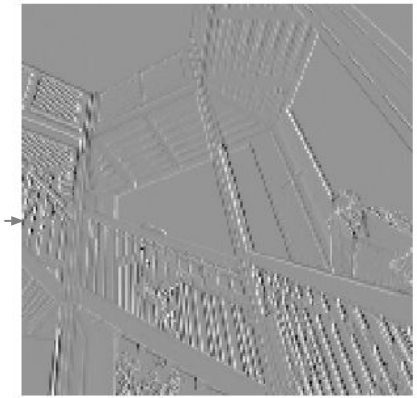
Convolutional Filter

Original

$$\begin{matrix} 1/6 & 0 & -1/6 \\ 1/6 & 0 & -1/6 \\ 1/6 & 0 & -1/6 \end{matrix}$$

Convolution

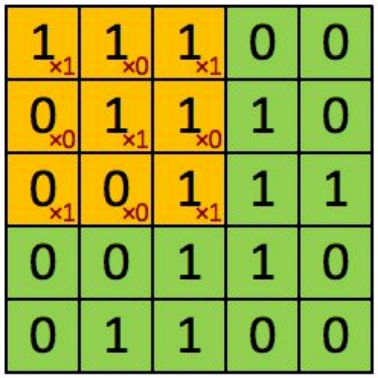
Filtered

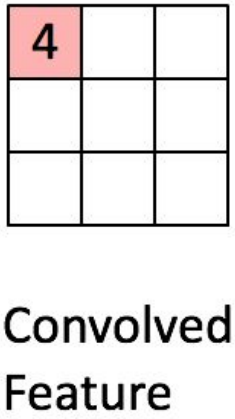


Edge Detection

What is DCGAN?

Convolution (Cross-Correlation)





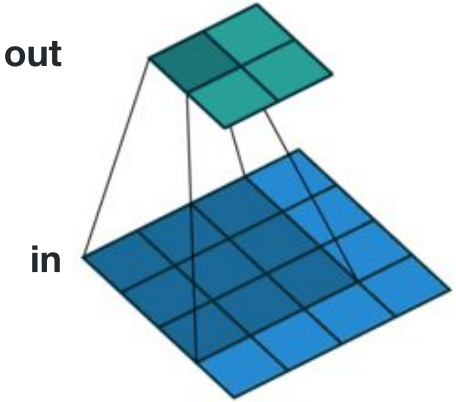
Parameters:
Size f
Stride s
Padding p

$$o = \frac{n + 2p - f}{s} + 1$$

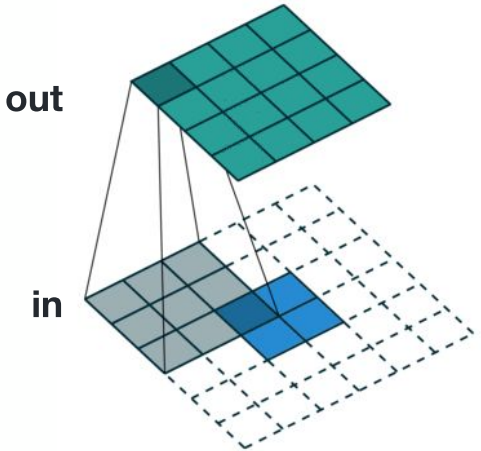
Image: Wikipedia

What is DCGAN?

Generative Adversarial Networks | Transpose Convolution or Fractionally Strided Convolution



convolution
no padding
stride 1

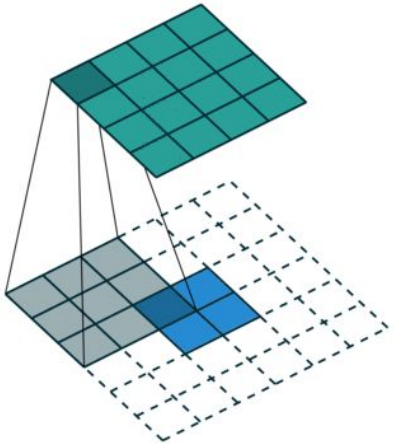


transposed convolution
no padding
stride 1

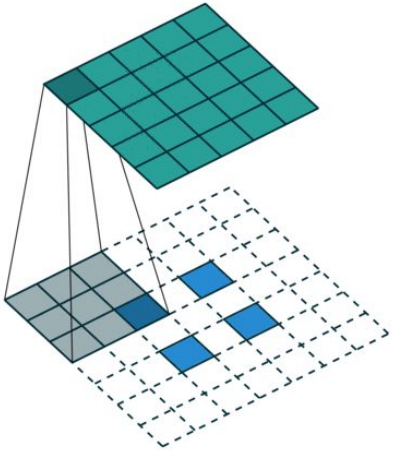
Dumoulin & Visin, 2016

What is DCGAN?

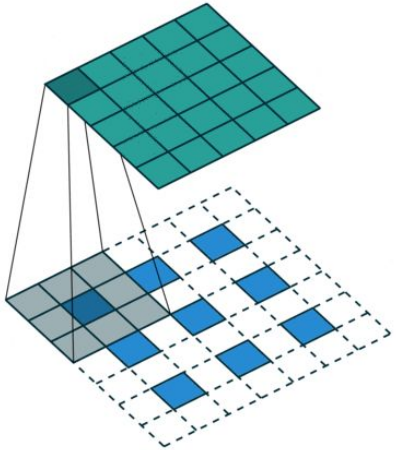
Generative Adversarial Networks | Transpose Convolution or Fractionally Strided Convolution



no padding
stride 1



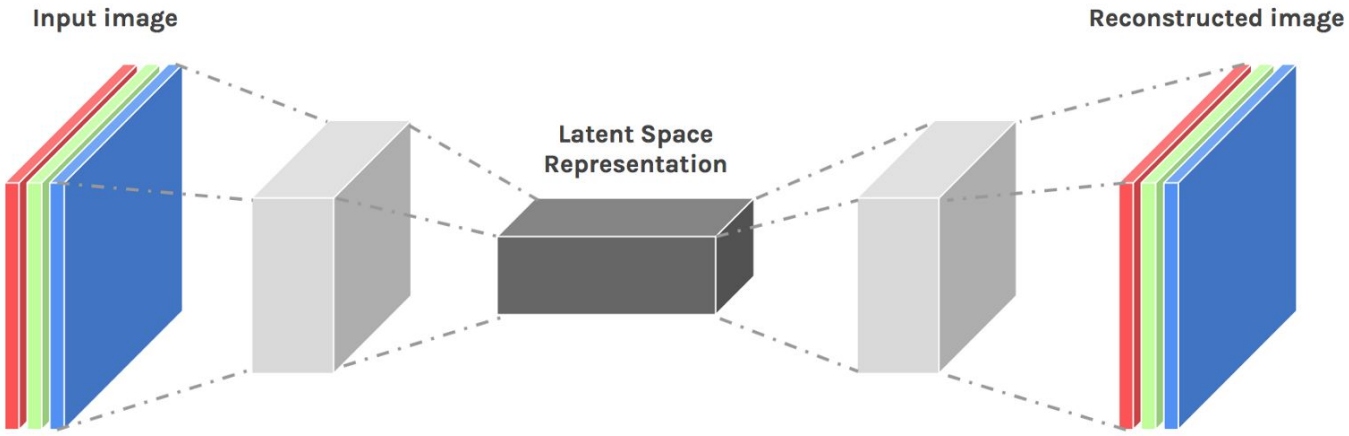
no padding
stride 2



padding
stride 2

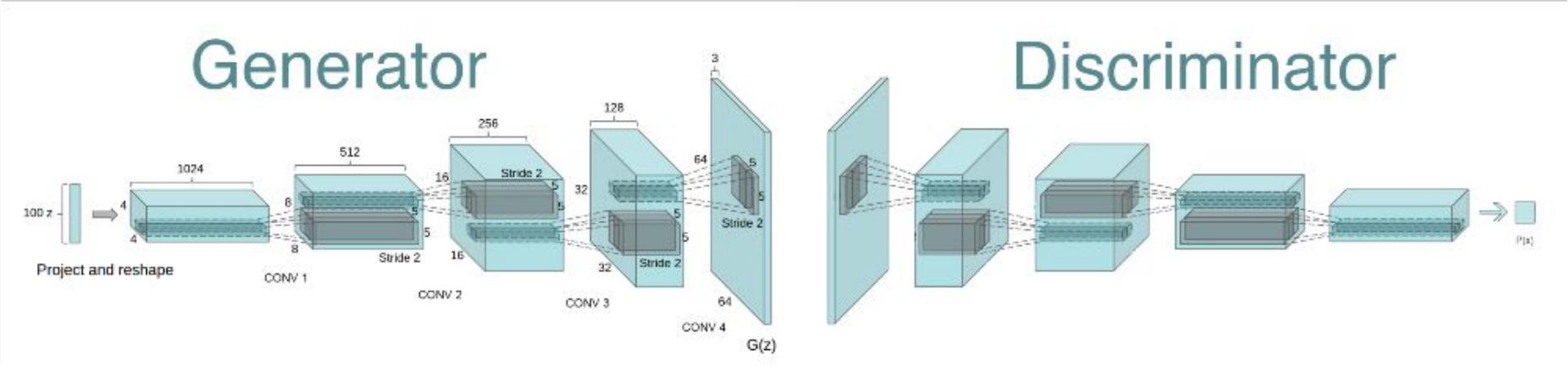
Dumoulin & Visin, 2016

What is DCGAN?



DCGAN Architecture
From Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks

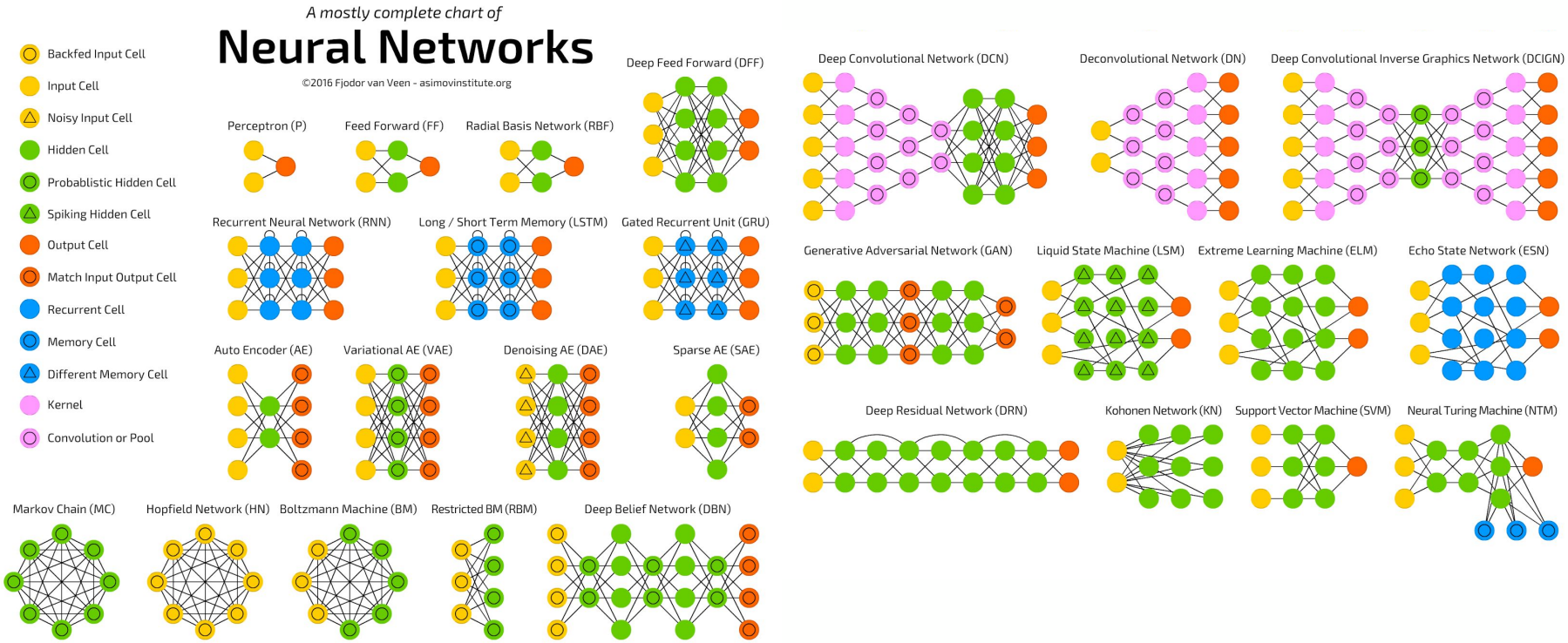
What is DCGAN?



DCGAN Architecture
From [Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks]

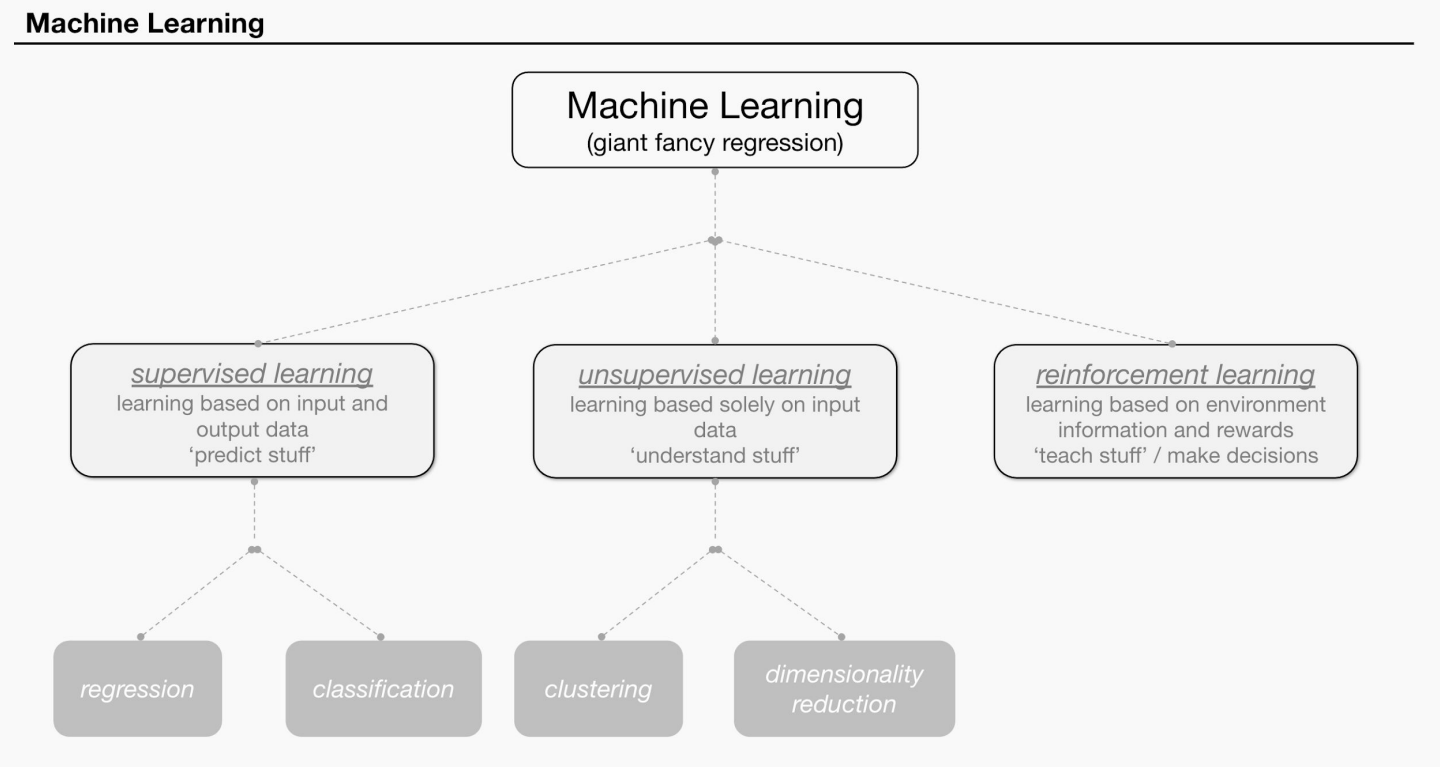
Back to the Code: dcgan_train_128.ipynb

Neural Networks



The Neural Network Zoo by the Asimov Institute

Types of Machine Learning



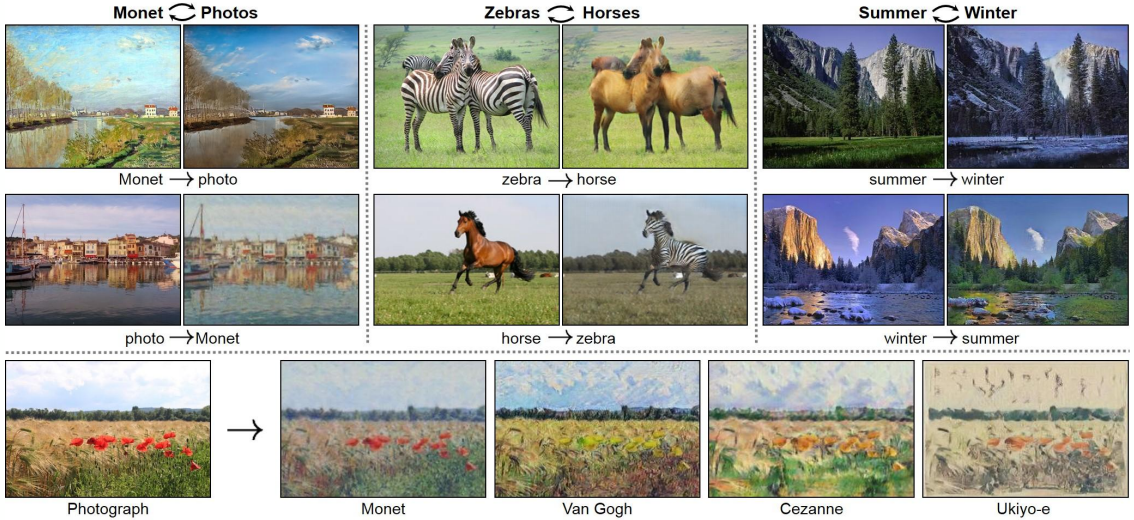
Creative Machine Learning for Design by Dr. Danhaive and Prof. Mueller

Types of GAN

GAN ZOO
https://github.com/hindupuravinash/the-gan-zoo

Tour of GAN models
https://machinelearningmastery.com/tour-of-generative-adversarial-network-models/

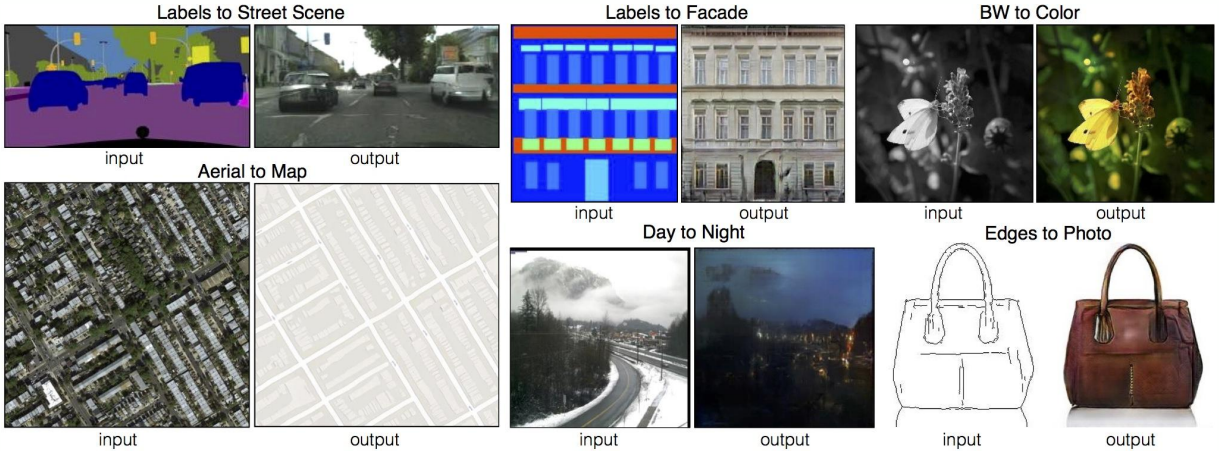
Types of GAN: CycleGAN



[Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks]

[Gentle Introduction to CycleGAN]

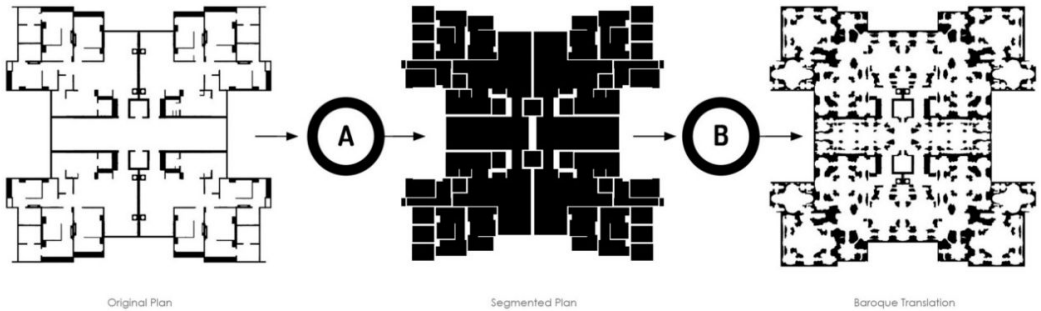
Types of GAN: “Pix2Pix”



[Image-to-Image Translation with Conditional Adversarial Networks]

[Gentle Introduction to Pix2Pix]

Types of GAN: StyleGAN



Modern-to-Baroque Floor Plan Translation | Source: Author

A Style-Based Generator Architecture for Generative Adversarial Networks

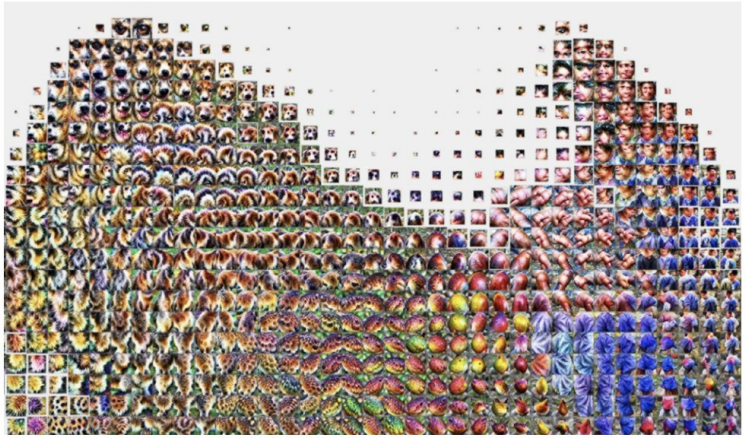
Gentle Introduction to StyleGAN

AI and Architecture: Experimental Perspective by Stanislas Chaillou

Neural Networks

Shark or Baseball? Inside the ‘Black Box’ of a Neural Network

New research from Google and OpenAI offers insight into how neural networks "learn" to identify images.



Using an "activation atlas," researchers can plumb the hidden depths of a neural network and study how it learns visual concepts. CARTER ET AL

Google DeepDream

Neural Networks

Google DeepDream

Back to the Code: dcgan_train_128.ipynb

Next Week...

We will begin with Training Show & Tell

Each group/individual presents the results for 1~2min