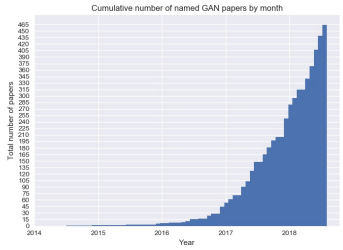
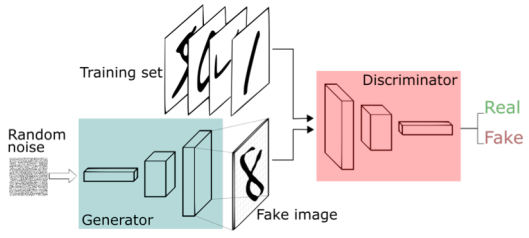
Project 5:
Generative Adversarial Network

Zhifei Zhang

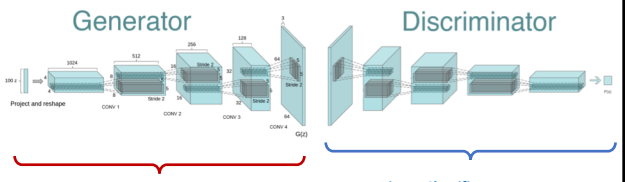
Generative Adversarial Network (GAN)



Generative Adversarial Network (GAN)



Generative Adversarial Network (GAN)

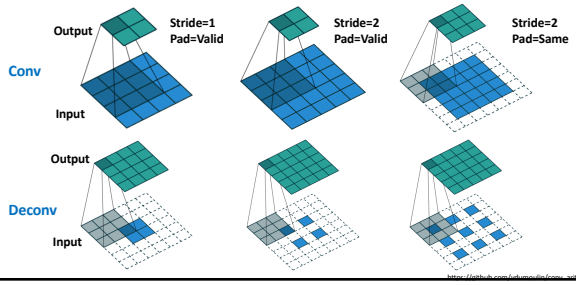


New components:
Transposed convolution,
Batch Normalization

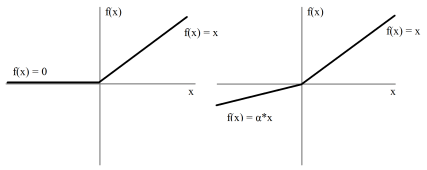
Binary Classifier:
Conv, Leaky ReLU,
FC, Sigmoid

https://github.com/PramodShenoy/GANerations

Transposed Convolution (Deconvolution)



ReLU vs. Leaky ReLU (LReLU)



Used in Generator

Used in Discriminator

Batch Normalization (BN)

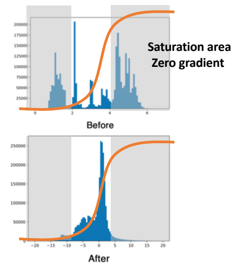
Input: Values of x over a mini-batch: $\mathcal{B} = \{x_{1...m}\}$;
Parameters to be learned: γ, β
Output: $\{y_i = \mathrm{BN}_{\gamma,\beta}(x_i)\}$

$$\mu_\mathcal{B} \leftarrow \frac{1}{m}\sum_{i=1}^{m} x_i \qquad \text{// mini-batch mean}$$

$$\sigma_\mathcal{B}^2 \leftarrow \frac{1}{m}\sum_{i=1}^{m} (x_i - \mu_\mathcal{B})^2 \qquad \text{// mini-batch variance}$$

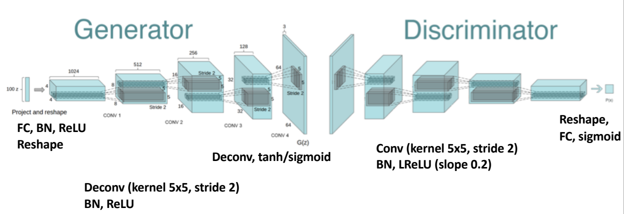
$$\widehat{x}_i \leftarrow \frac{x_i - \mu_\mathcal{B}}{\sqrt{\sigma_\mathcal{B}^2 + \epsilon}} \qquad \text{// normalize}$$

$$y_i \leftarrow \gamma \widehat{x}_i + \beta \equiv \mathrm{BN}_{\gamma,\beta}(x_i) \qquad \text{// scale and shift}$$



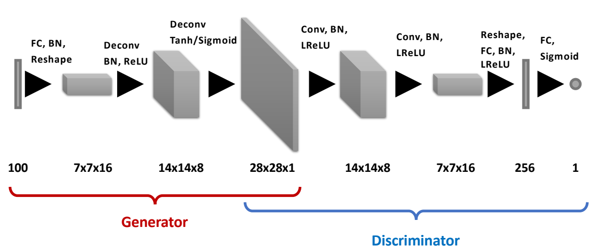
https://towardsdatascience.com/batch-normalization-in-neural-networks-1ac91516821c

Generative Adversarial Network (GAN)

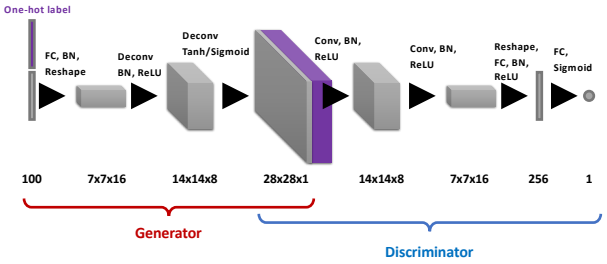


https://github.com/PramodShenoy/GANerations

GAN on MNIST



Conditional GAN on MNIST



TensorFlow Implementation of GAN

Run the demo code: (Linux or MacOS)

$ git clone https://github.com/carpedm20/DCGAN-tensorflow

$ cd DCGAN-tensorflow

$ pip install tqdm (if you do not have this package)

$ python download.py mnist

$ python main.py --dataset mnist --input_height=28 --output_height=28 --train

TensorFlow Implementation of GAN

- Input: z, image, (label)
- Network: D, G
- Loss: D, G
- Optimizer: D, G

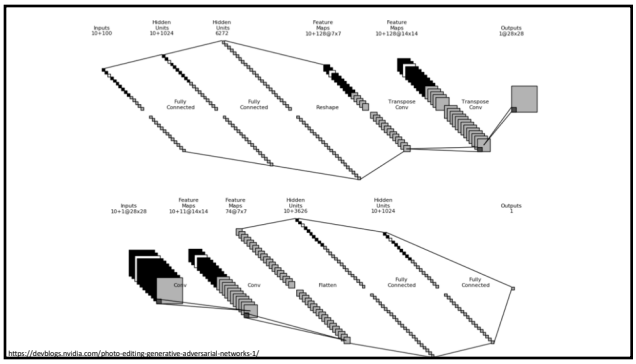
Training:

for epoch

  for batch

    Update D

    Update G



TensorFlow Implementation of GAN

Testing:

- **Random Generation**
- **Conditional Generation**
- **Interpolation**