



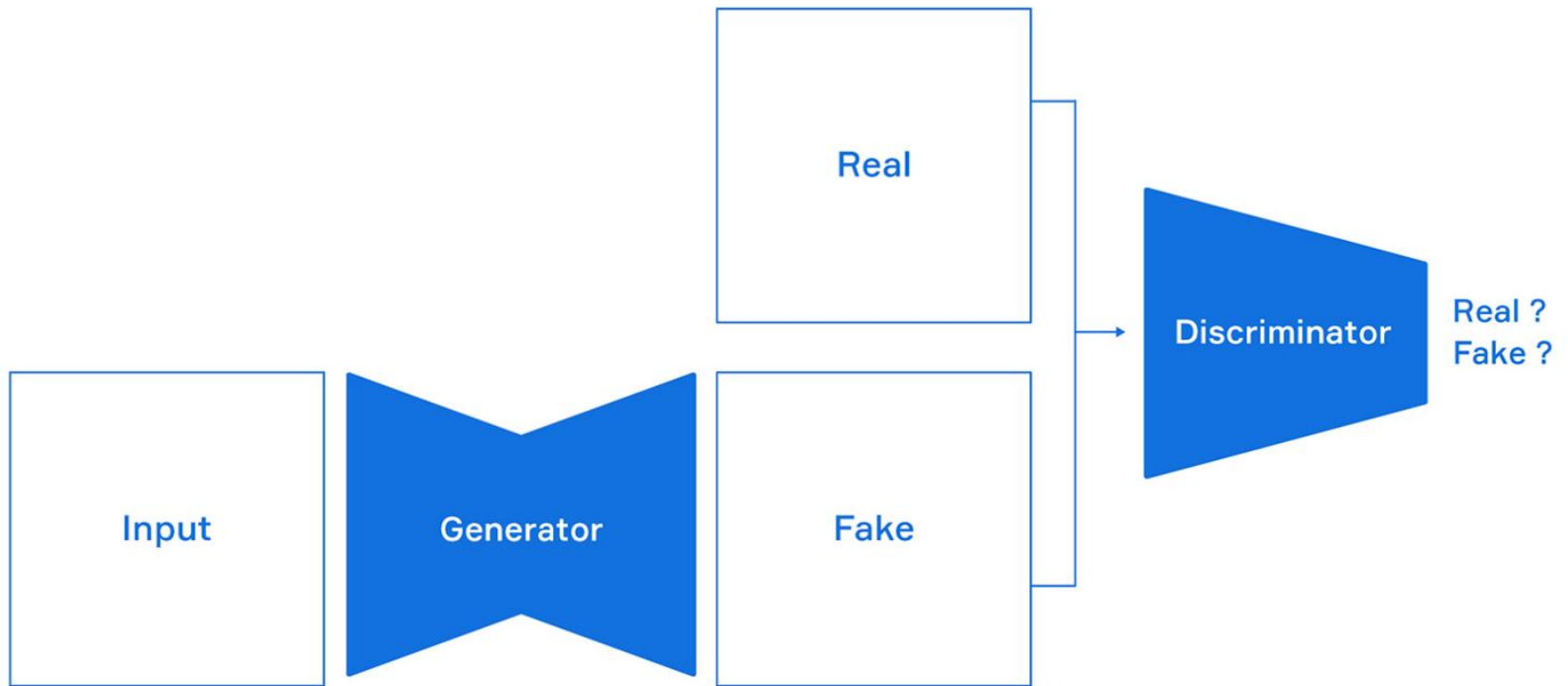
Generative Adversarial Network

정승환

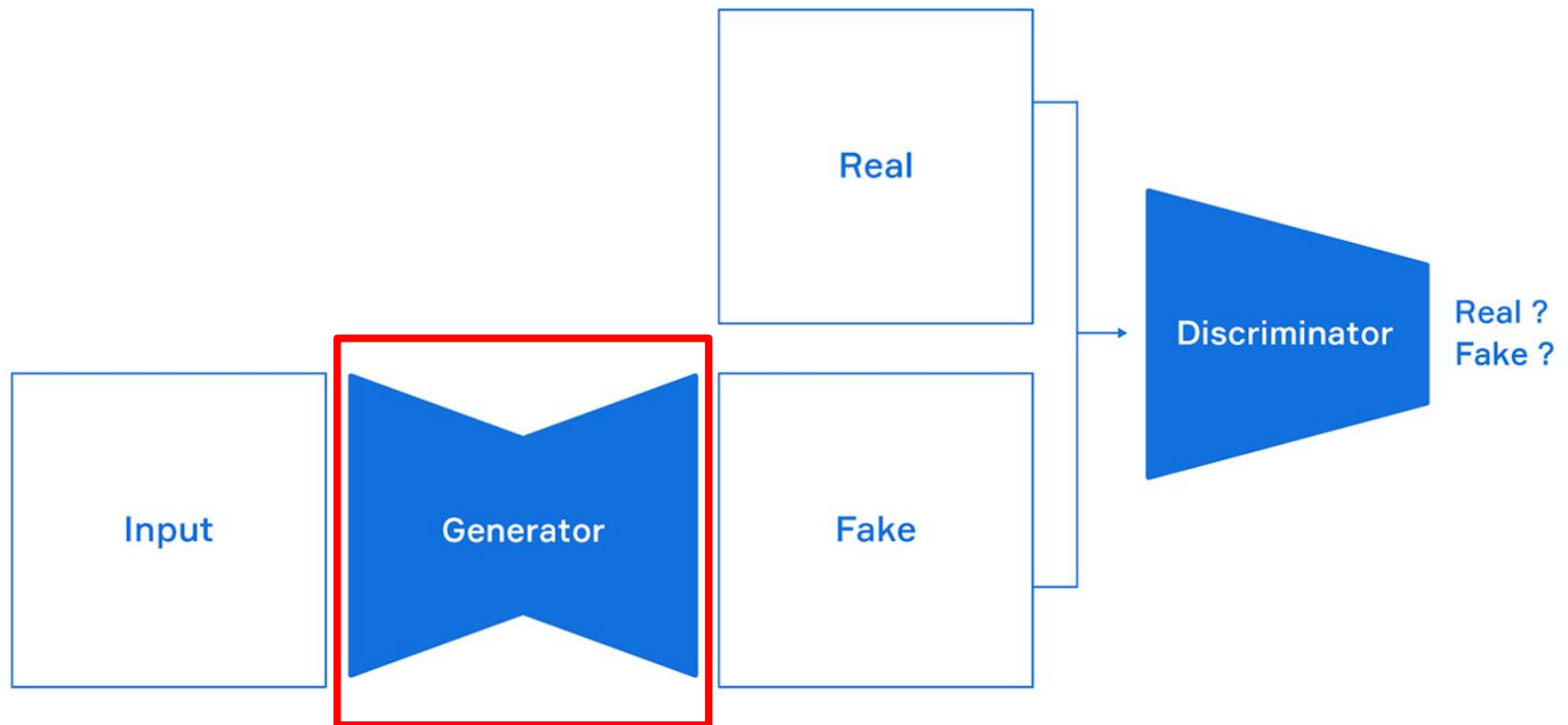
2018.07.07



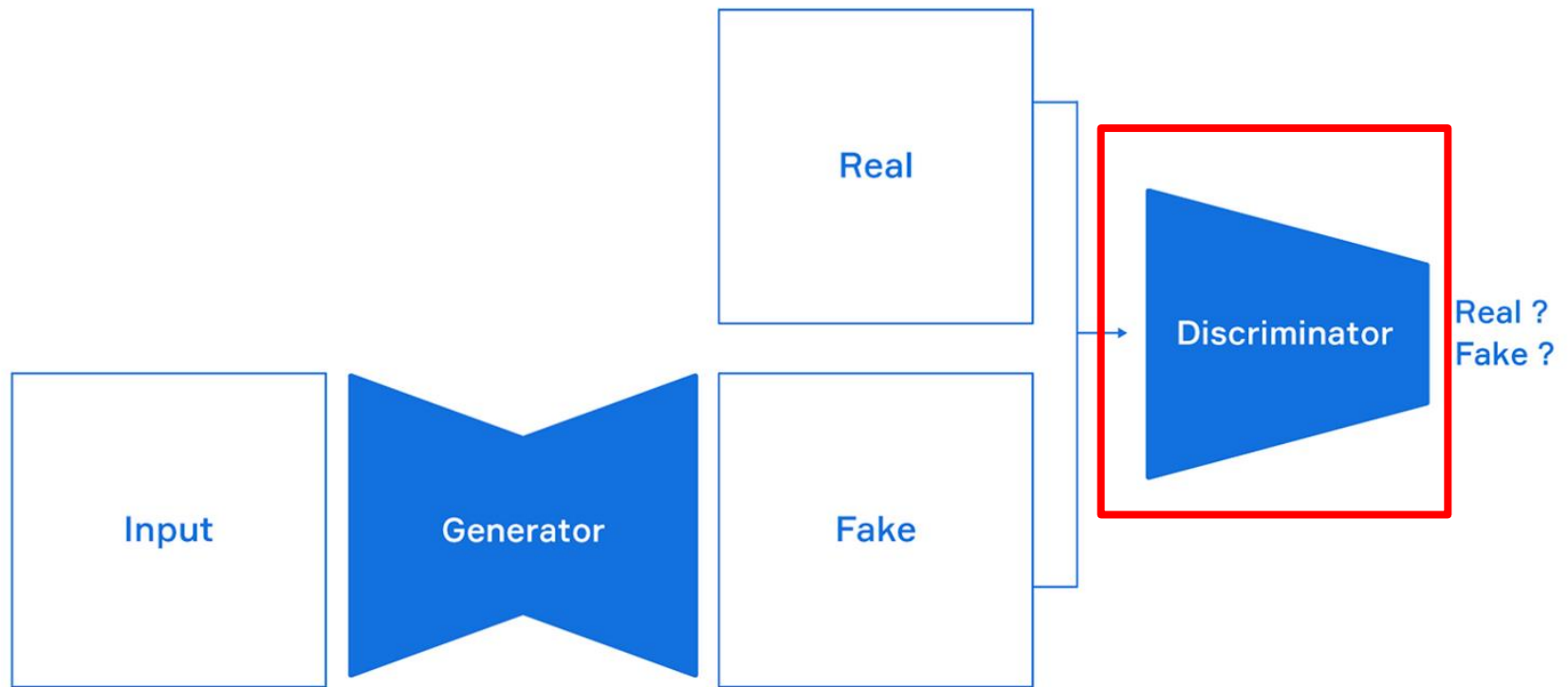
GAN의 주요 Concept



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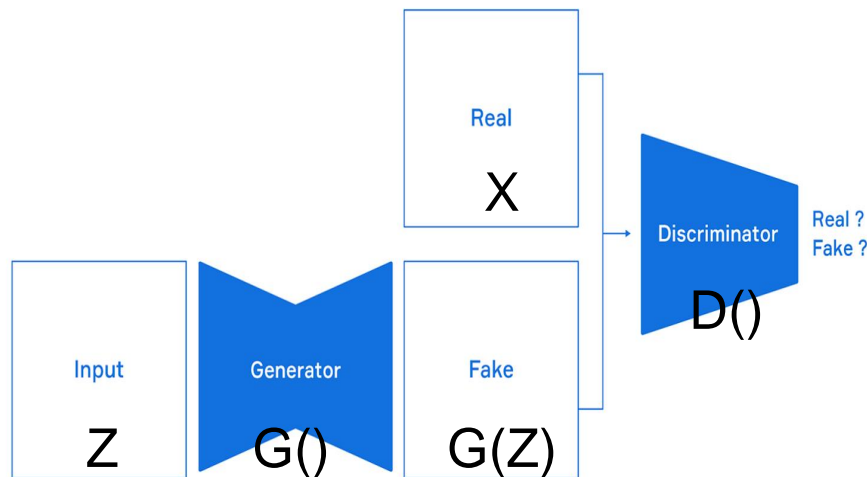
$$\min_G \max_D V(D, G) = \mathbb{E}_{\mathbf{x} \sim p_{\text{data}}(\mathbf{x})} [\log D(\mathbf{x})] + \mathbb{E}_{\mathbf{z} \sim p_{\mathbf{z}}(\mathbf{z})} [\log(1 - D(G(\mathbf{z})))] \quad (1)$$

real 데이터 입력시 산출되는 값

fake 데이터 입력 시 산출되는 값



GAN의 주요 Concept



[arg max D]

- 첫번째 항은 real Data 입력때 목적함수 값
- 두번째 항은 fake Data 입력때 목적함수 값
 - 1- 형태이기 때문에 G(Z) 는 극소화가 됨

[arg min D]

- real Data 일 경우 큰 값을 fake Data를 넣을 경우에는 작은 값을 반환하도록 D를 학습 시킴
- 1- 형태이기 때문에 D(G(Z)) 를 극대화 함

→ fake Data 로 생성된 결과로 D())를 속이

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

DCGAN

GAN 적용 관련 이슈

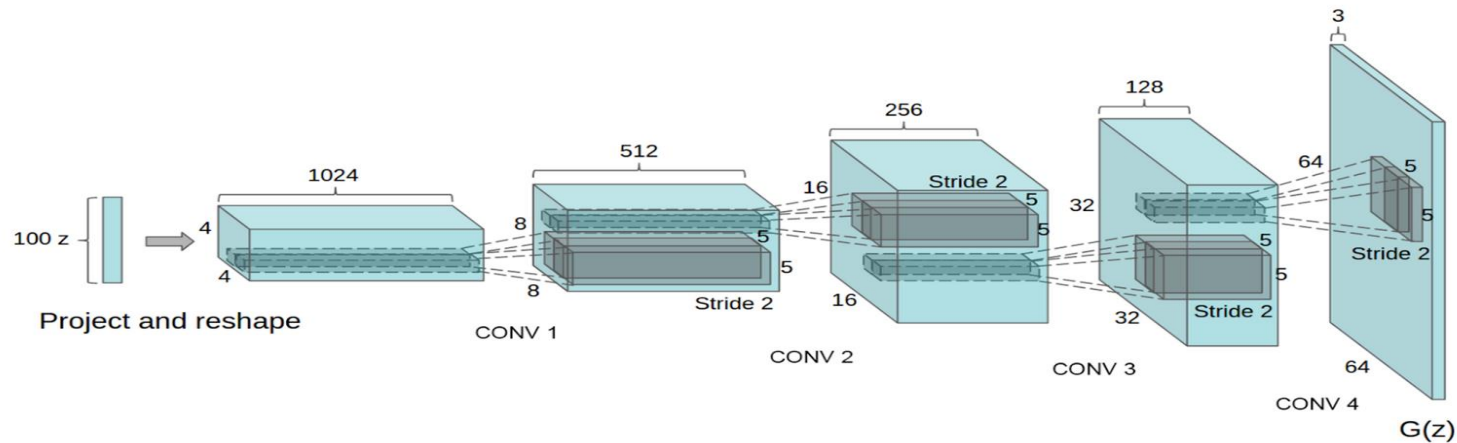
- 불안정한 구조로 인한 학습의 어려움
- 학습된 후에도 결과를 Generation 하여도 결과가 일정하게 나오지 않는 현상이 발생

DCGAN

- Deep Convolution GAN
- CNN을 통해 GAN을 구현함
- 장점
 - 안정적으로 학습하는 GAN 구조를 제안함

DCGAN

Network Structure



Architecture guidelines for stable Deep Convolutional GANs

- Replace any pooling layers with strided convolutions (discriminator) and fractional-strided convolutions (generator).
- Use batchnorm in both the generator and the discriminator.
- Remove fully connected hidden layers for deeper architectures.
- Use ReLU activation in generator for all layers except for the output, which uses Tanh.
- Use LeakyReLU activation in the discriminator for all layers.

Batch Normalization

- mini-batch 기준으로 하여 평균/표준편차를 산출한 이후에 normalize를 수행하고 scale factor와 shift factor을 이용해서 새로운 값을 산출

Input: Values of x over a mini-batch: $\mathcal{B} = \{x_{1...m}\}$;

Parameters to be learned: γ, β

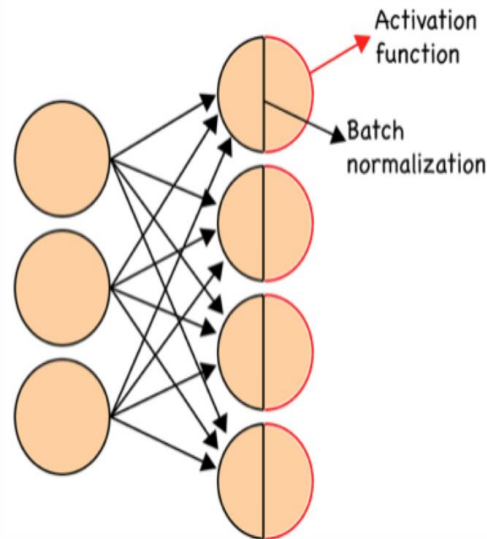
Output: $\{y_i = \text{BN}_{\gamma, \beta}(x_i)\}$

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

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

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

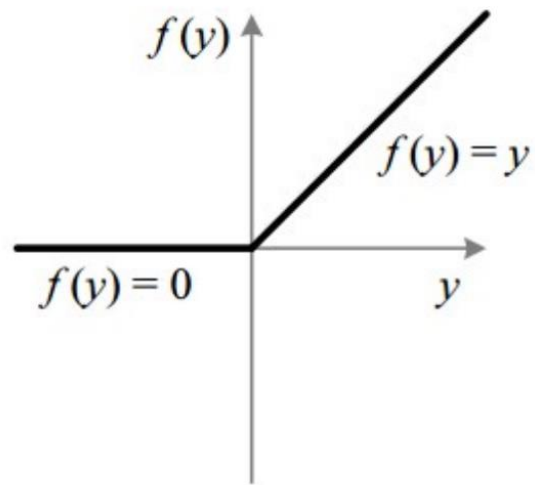
$$y_i \leftarrow \gamma \hat{x}_i + \beta \equiv \text{BN}_{\gamma, \beta}(x_i) \quad // \text{ scale and shift}$$



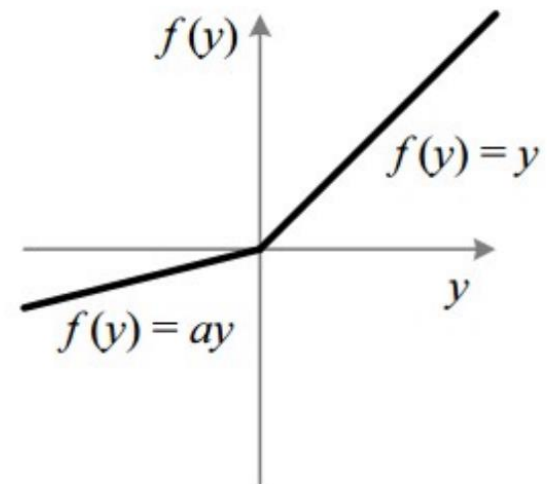
$$\hat{x}_i \leftarrow \frac{x_i - \mu_{\mathcal{B}}}{\sqrt{\sigma_{\mathcal{B}}^2 + \epsilon}}$$
$$y_i \leftarrow \gamma \hat{x}_i + \beta \equiv \text{BN}_{\gamma, \beta}(x_i)$$

LeakyReLU

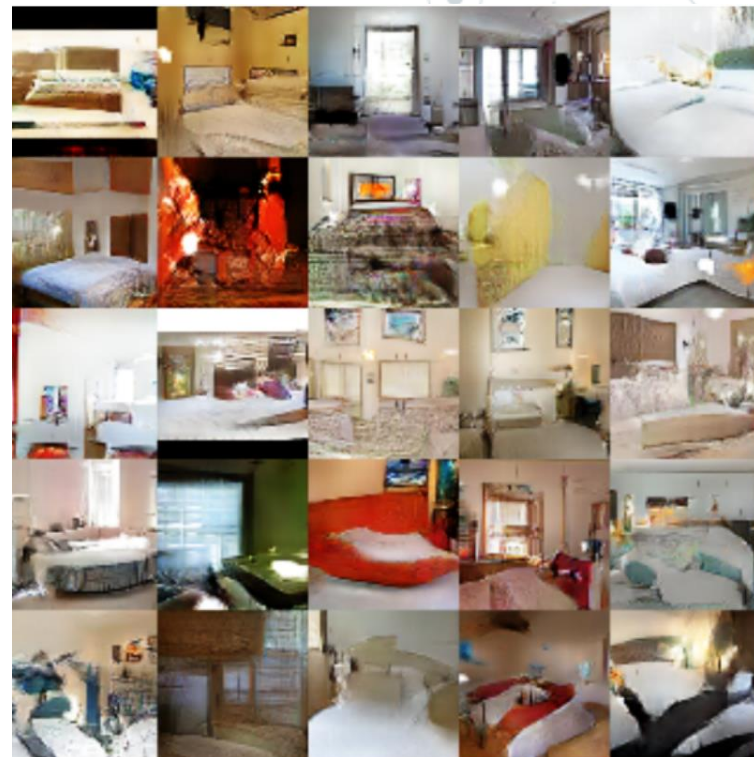
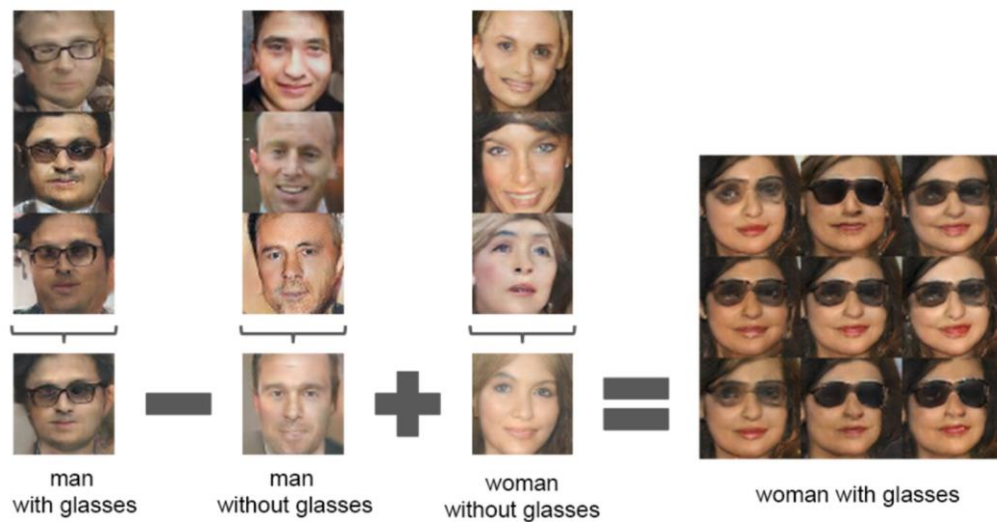
ReLU(Rectified Linear Unit)



Leaky ReLU
(Rectified Linear Unit)



DCGAN





Thanks!

Any questions?