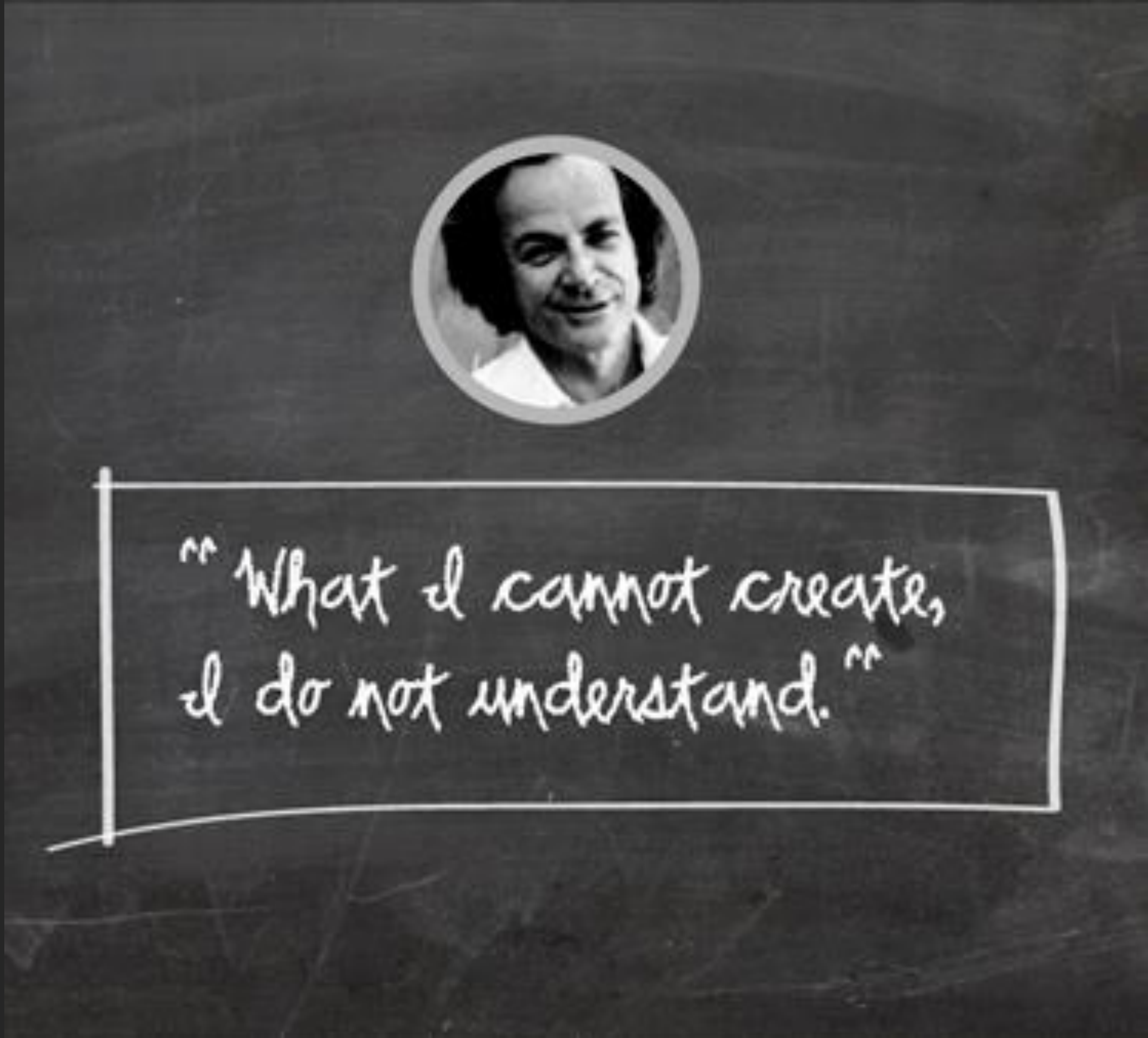
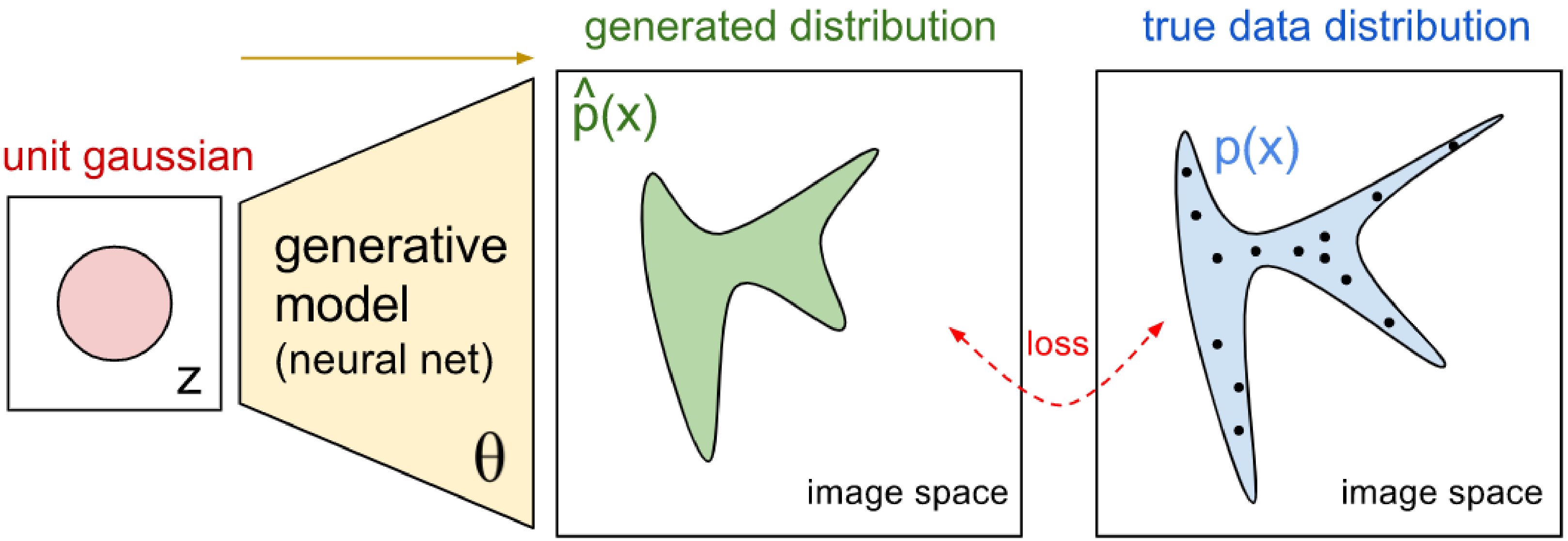
Generative models

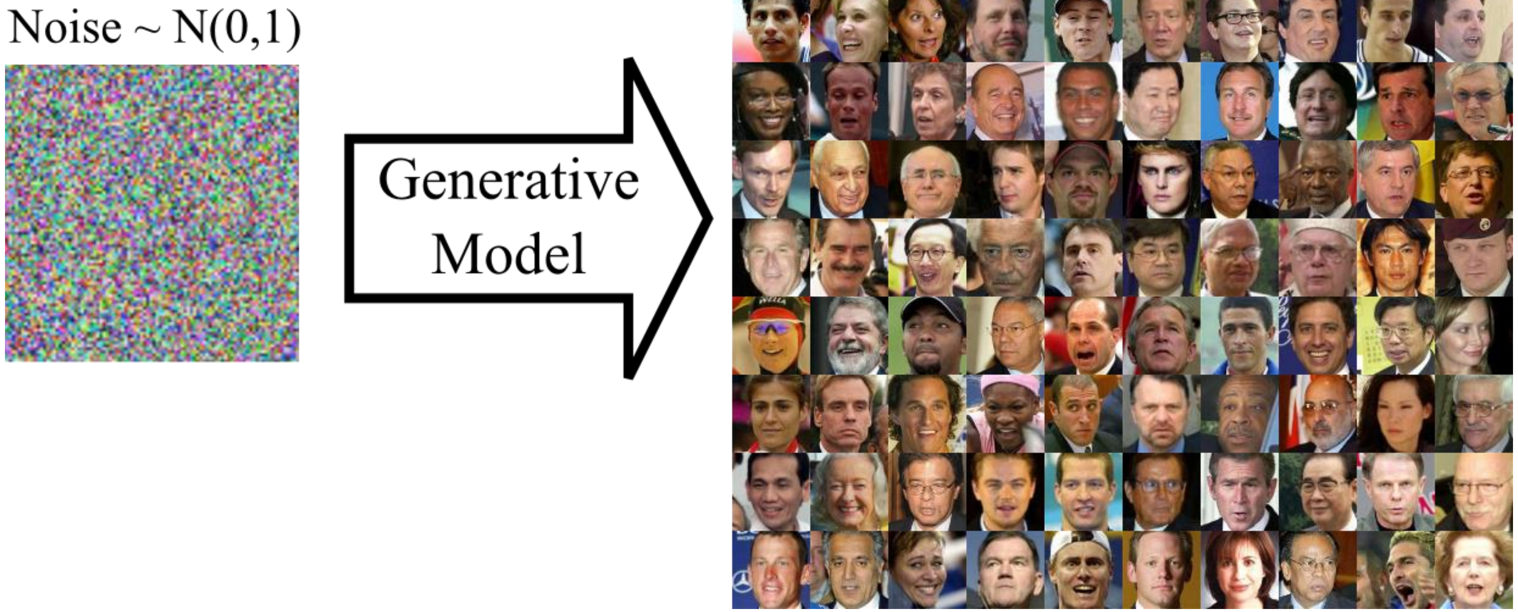
JI XIA



What is generative model?



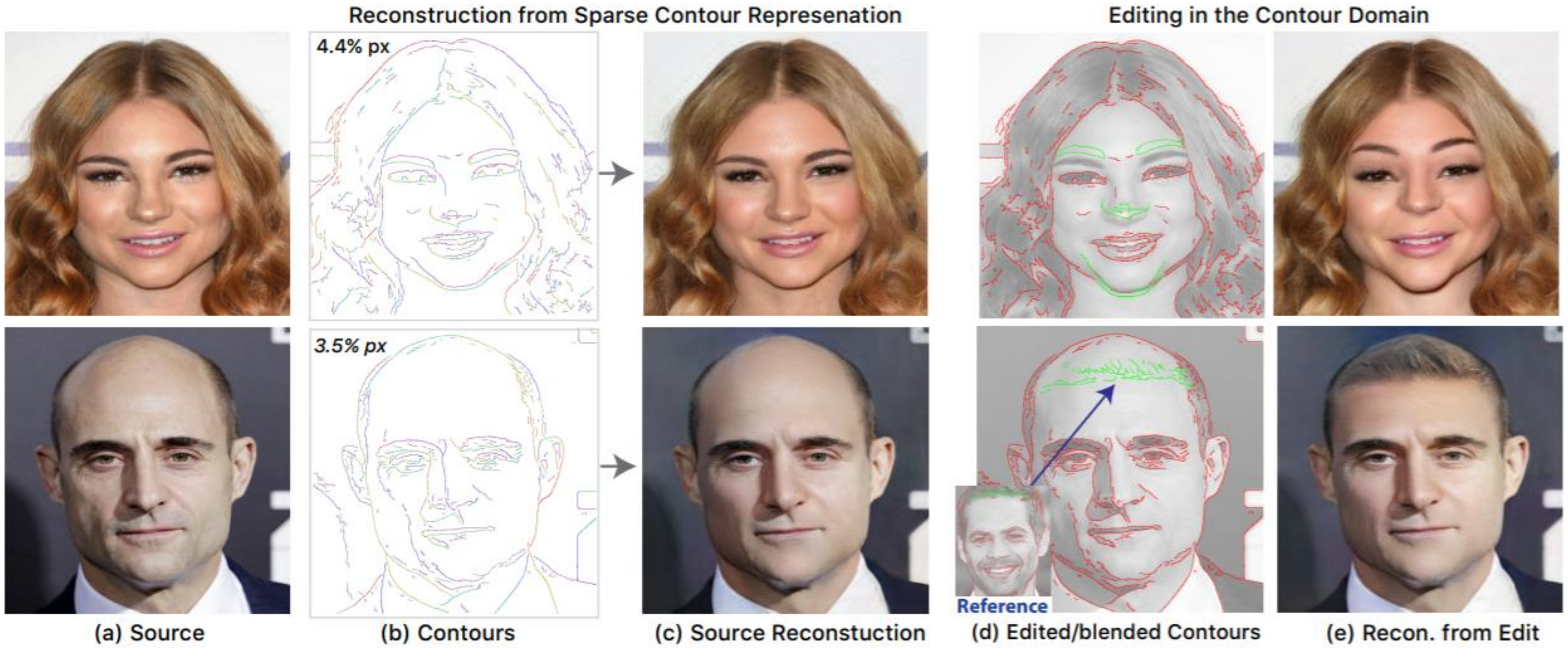
Applications of generative model



Noise ~ $N(0,1)$

Generative Model

Applications of generative model

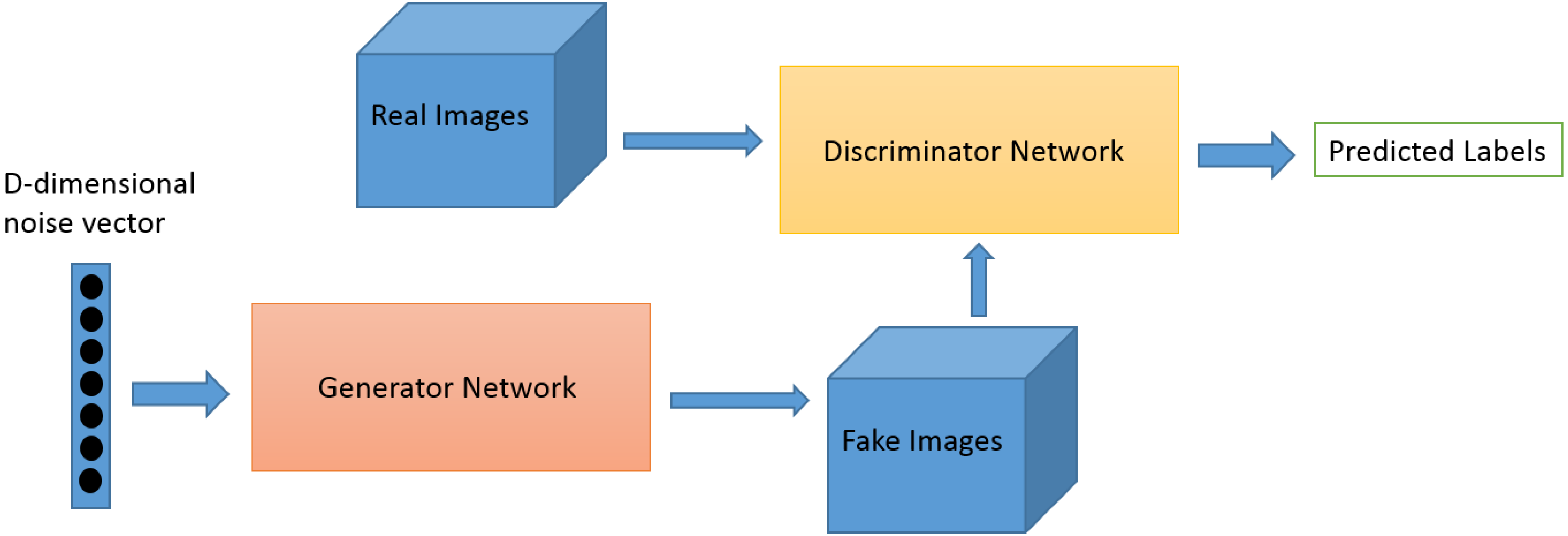

Reconstruction from Sparse Contour Represenation
Editing in the Contour Domain
4.4% px
3.5% px
Reference
(a) Source
(b) Contours
(c) Source Reconstuction
(d) Edited/blended Contours
(e) Recon. from Edit

“Sparse, Smart Contours to Represent and Edit Images” CVPR 2018

Two popular methods for generative model

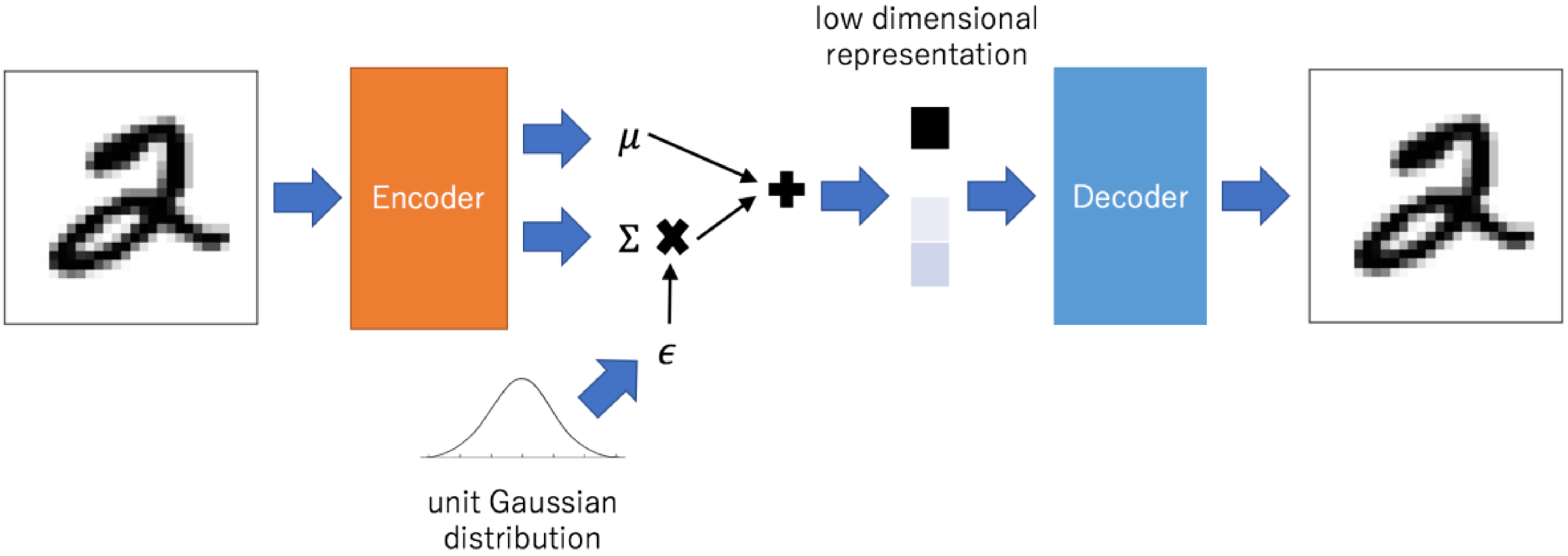
1. Generative adversarial network
2. Variational autoencoder

Generative adversarial network (GAN)

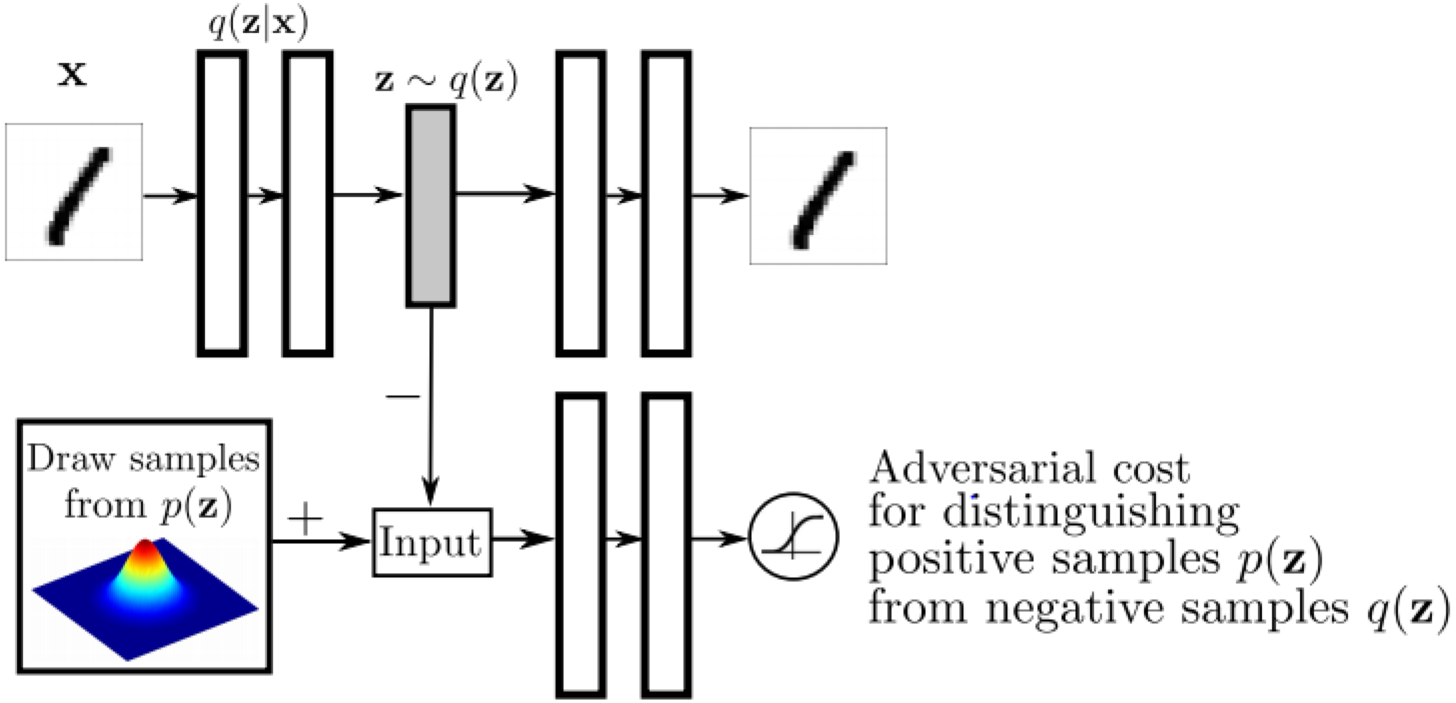


Variational autoencoder (VAE)

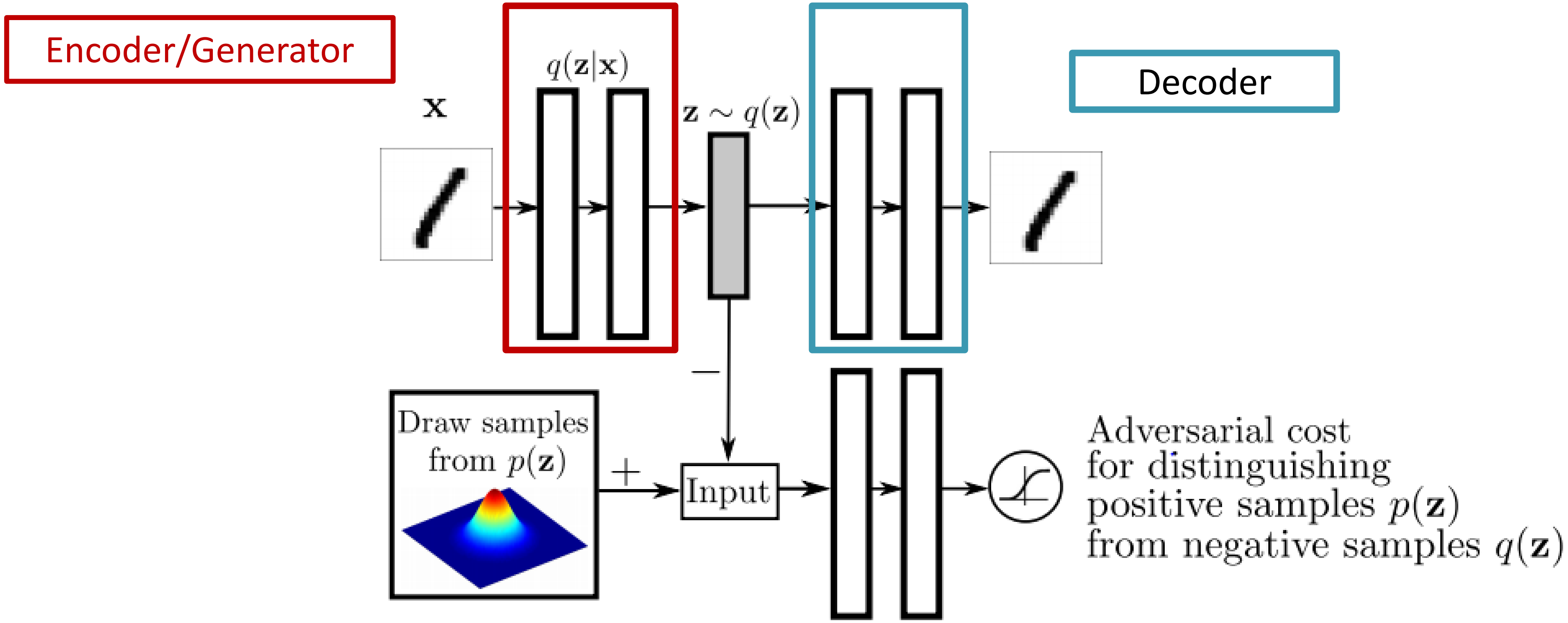
Task: map from **unit Gaussian distribution** to **hand written digit distribution**.



Adversarial autoencoder (AAE)


$\mathbf{x}$
$q(\mathbf{z}|\mathbf{x})$
$\mathbf{z} \sim q(\mathbf{z})$
$-$
Draw samples from $p(\mathbf{z})$
$+$
Input
Adversarial cost for distinguishing positive samples $p(\mathbf{z})$ from negative samples $q(\mathbf{z})$

Adversarial variational autoencoder (AAE)



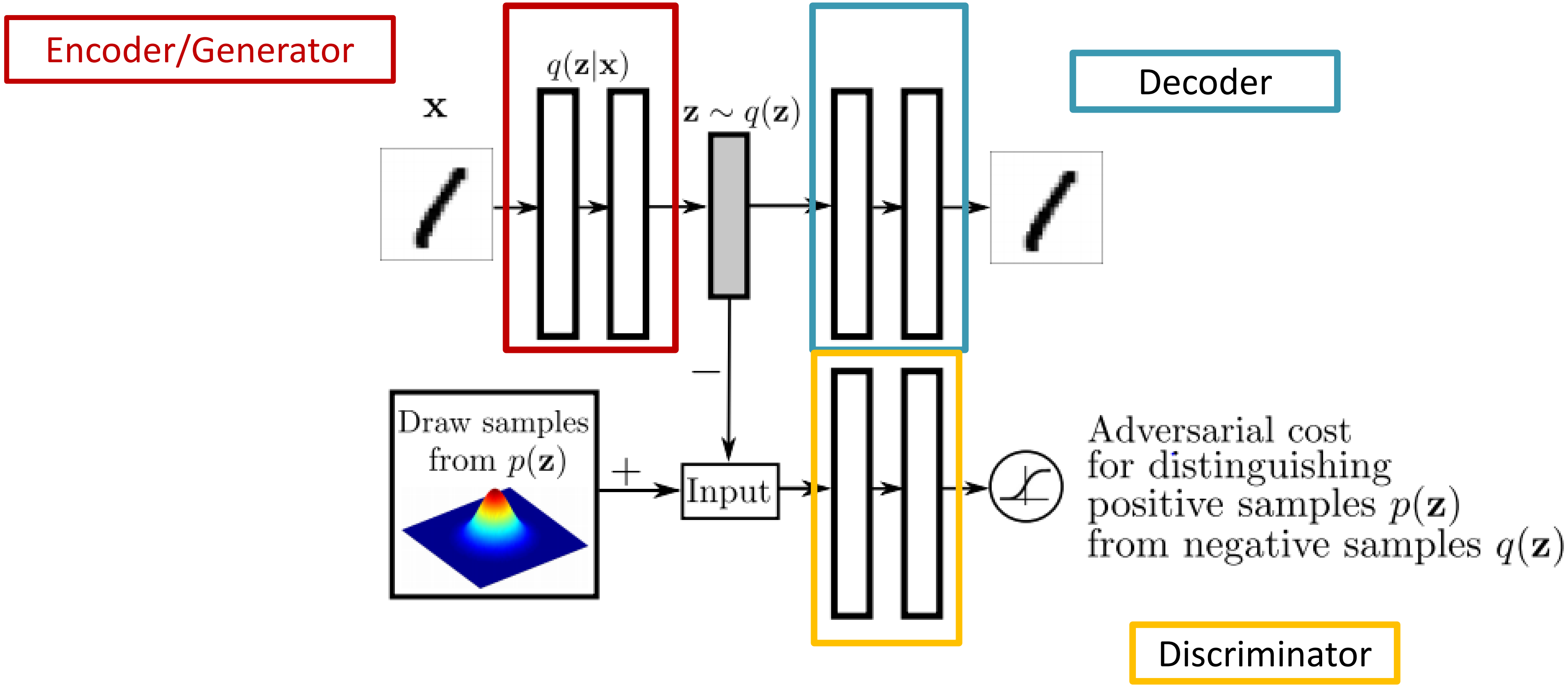
Encoder/Generator

Decoder

$\mathbf{x}$
$q(\mathbf{z}|\mathbf{x})$
$\mathbf{z} \sim q(\mathbf{z})$
$-$
Draw samples from $p(\mathbf{z})$
$+$
Input

Adversarial cost for distinguishing positive samples $p(\mathbf{z})$ from negative samples $q(\mathbf{z})$

Adversarial variational autoencoder (AAE)



Encoder/Generator

Decoder

Discriminator

Adversarial cost for distinguishing positive samples $p(\mathbf{z})$ from negative samples $q(\mathbf{z})$

$\mathbf{x}$
$q(\mathbf{z}|\mathbf{x})$
$\mathbf{z} \sim q(\mathbf{z})$
$-$
Draw samples from $p(\mathbf{z})$
$+$
Input

Advantage of AAE

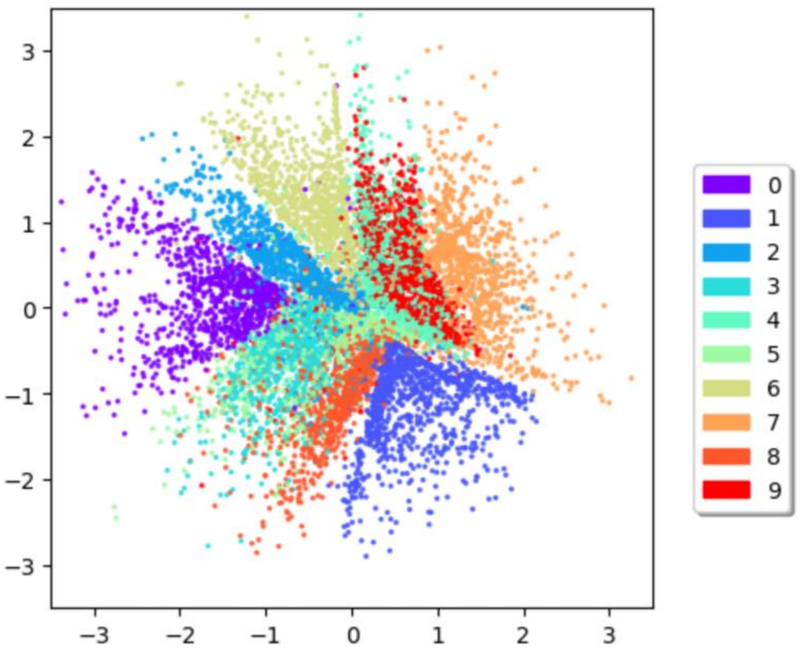
AAE outperforms VAE.

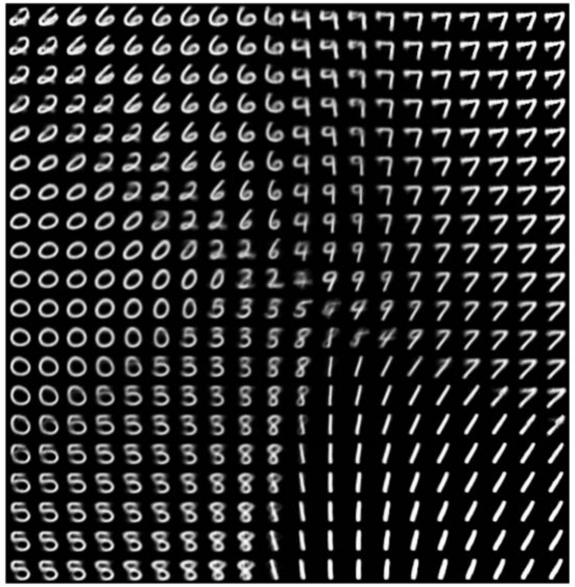
Because it’s matching latent variables distribution to designed distribution using adversarial training instead of minimizing KL divergence.

AAE outperforms GAN.

Because it’s imposing a low-dimensional distribution (on latent variables) instead of high-dimensional distribution (on images).

Task: Using AAE to generate handwritten digits.





Let’s look at the code now.

Folder Organization

- **experiment: main function**
- src
  - dataflow: import dataset
  - helper: some functions that helps training or visualizing
  - models
    - **aae: define AAE class**
    - **modules: encoder; decoder; discriminator; training function**
    - layers: functions used in layers of neural networks