Applied Machine Learning

Autoencoders - Codes from Probability Distributions

Autoencoders
Codes from Probability Distributions

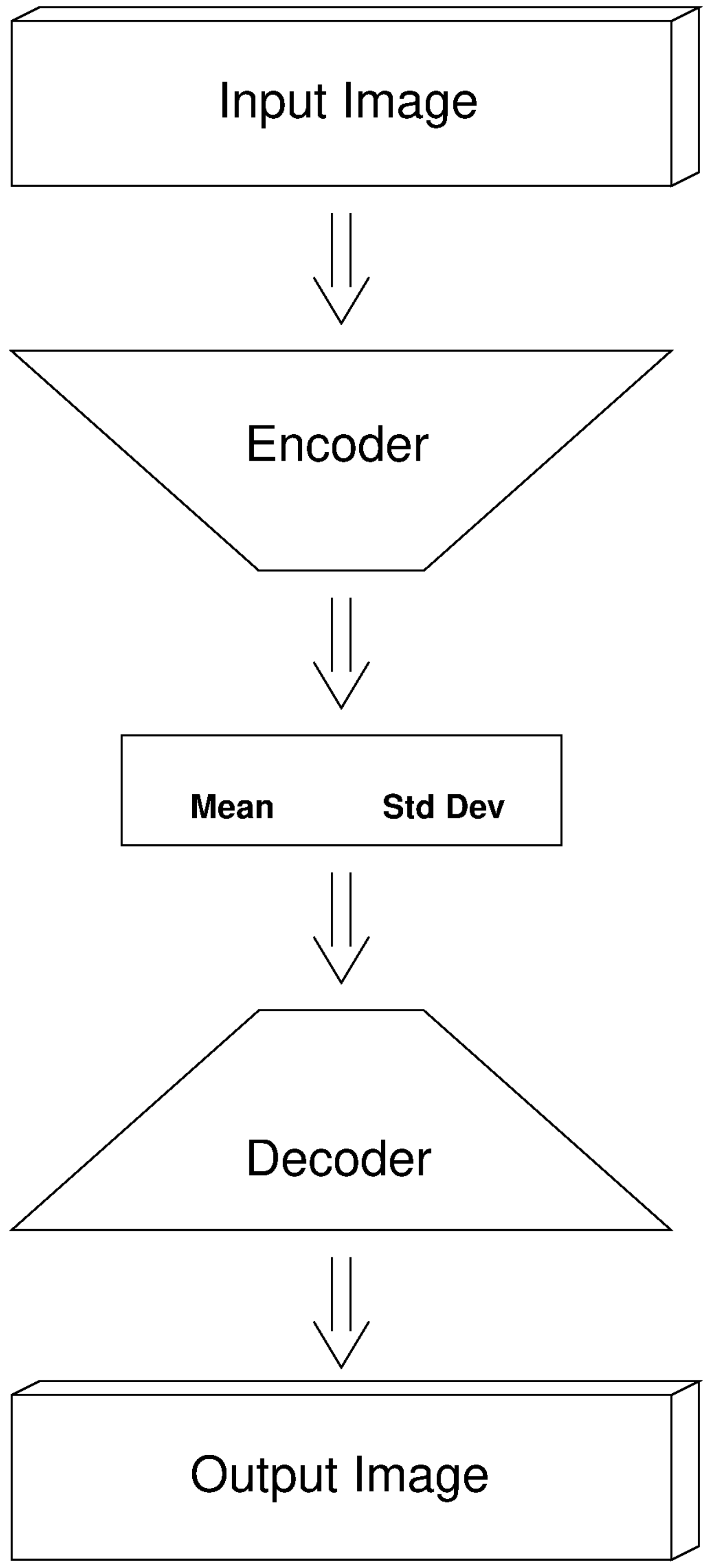
- Variational Autoencoders
- Generative Adversarial Networks

Variational Autoencoders

- Codes drawn from a probability distributions
  - Produce outputs that are probabilistically similar to the input
- Probability distributions
  - mixture of normals
  - one normal per training example
- Outputs drawn from code probability distribution corresponding to input
- Generate random images similar to the ones in the training set

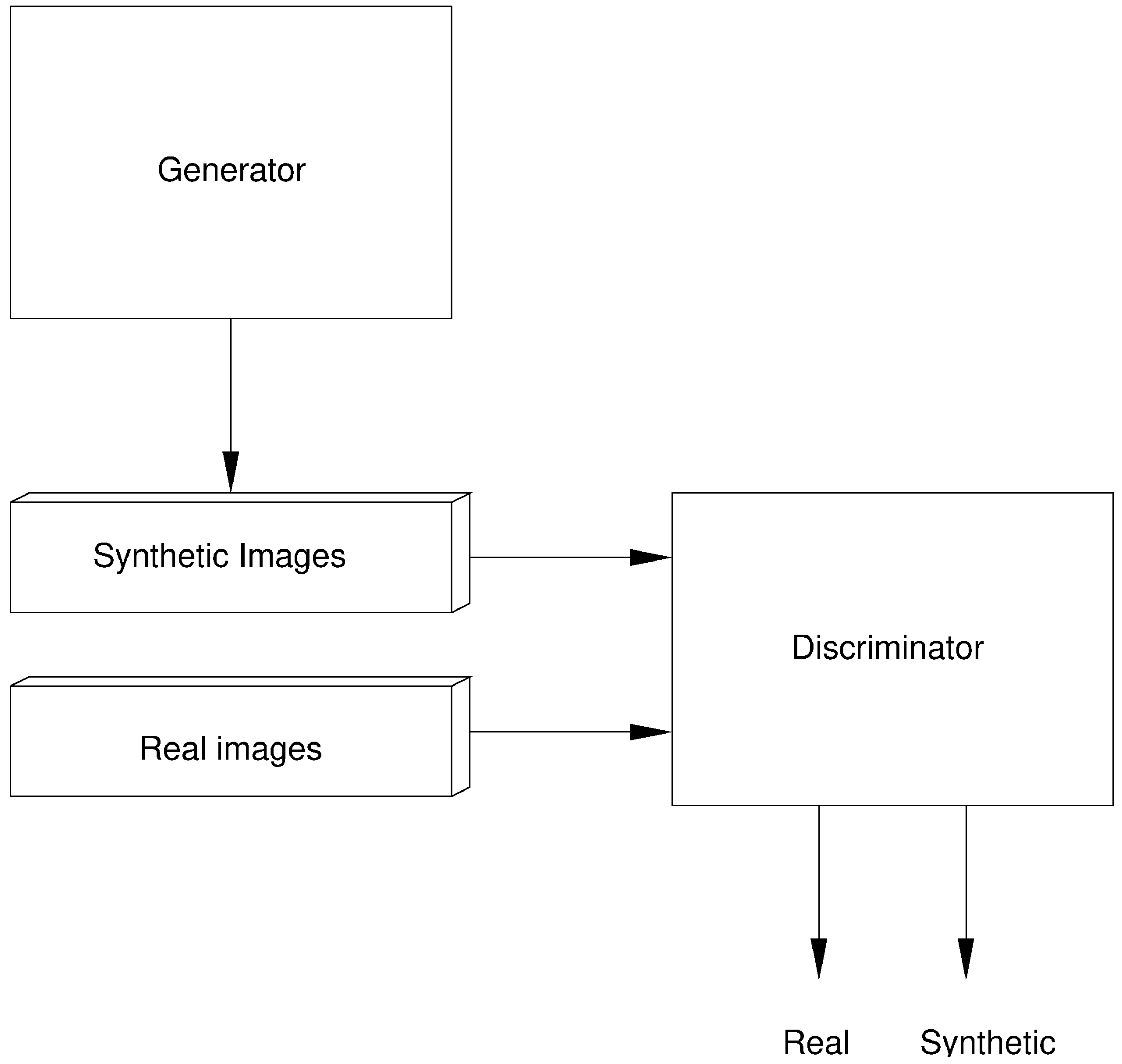
Variational Autoencoders - Loss

- Encoder
  - Input: Image
  - Output: mean and standard deviation of codes
  - Loss uses KL divergence between code distribution and normal distribution
- Decoder
  - Input: sample from distribution of code
  - Output: Image
  - Loss uses distance between decoder and input to the encoder



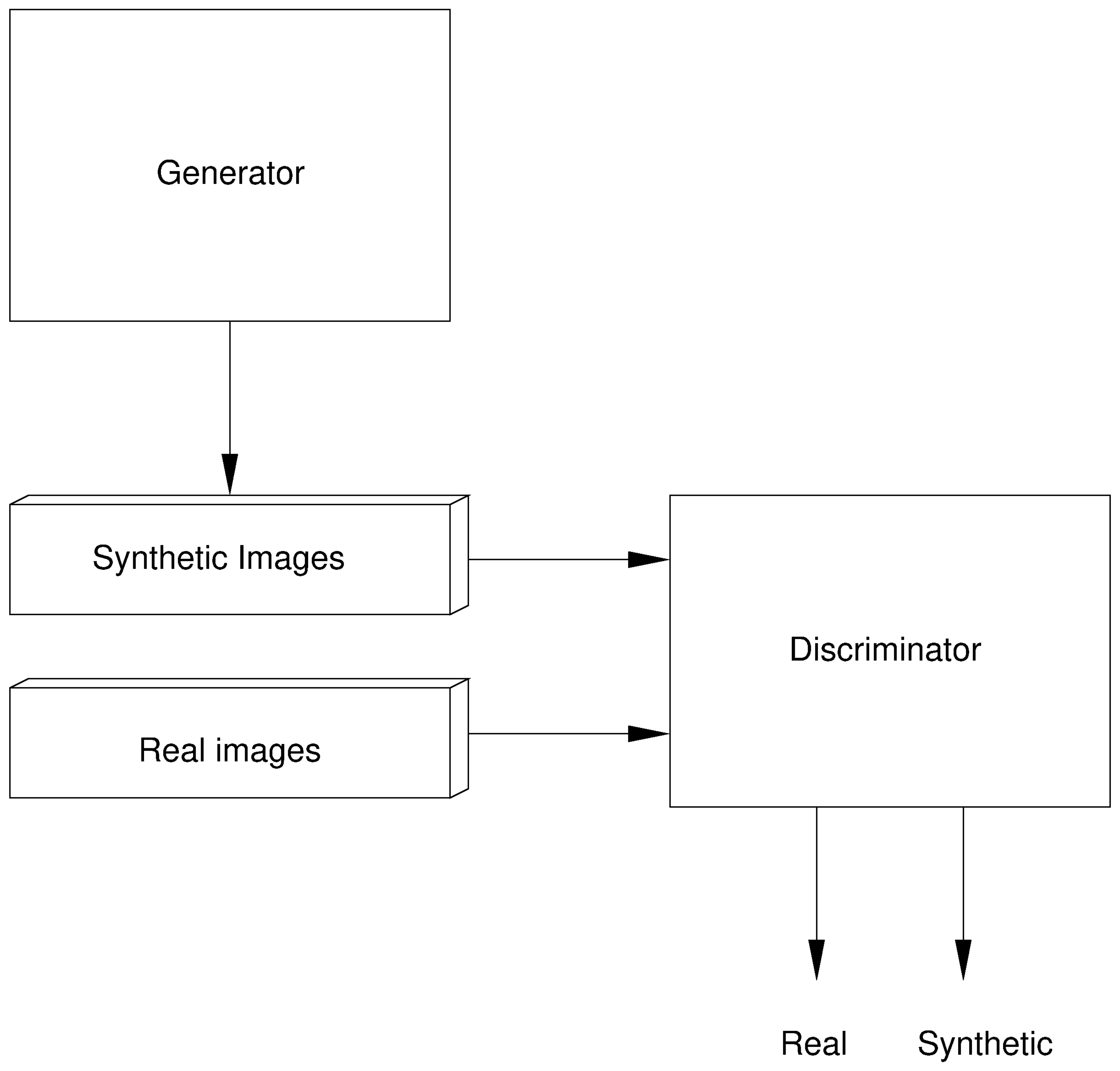
Generative Adversarial Networks

- Adversarial Generator and Discriminator Networks
- Generator Decoder
  - Input: stream of random codes drawn from a distribution
  - Output: produce synthetic images
    - goal: make discriminator classify them as real
- Discriminator Classifier
  - Trained to correctly classify images as real or synthetic



Generative Adversarial Networks - Cost Function

- Dataset of real images X
- Generator G
  - from distribution of code $\mathbf{z}$ in set of codes Z
  - generate image $G(\mathbf{z})$
- Discriminator D
  - classify input image $\mathbf{x}$ as $D(\mathbf{x}) \in [0$ (synthetic),1(real)].
- Cost function
  - $C(D,G) = \frac{1}{N_r}\sum_{\mathbf{x}_i \in X} \log(D(\mathbf{x}_i)) + \frac{1}{N_s}\sum_{\mathbf{z}_j \in Z} \log(1 - D(G(\mathbf{z}_j)))$
- Generator G to minimize cost, discriminator D to maximize cost
  - stochastic gradient descent/ascent
    - fix G, move through gradient in ascent direction updating D
    - fix D, move through gradient in descent direction updating G



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