Generative Adversarial Networks

DL 2.0. Workshop
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What is a Generative Model?

Generative

- Produces samples from a distribution.

- Input:
    - source of randomness,
    - class label,
    - latent variable, etc.

- Output: a sample from the target distribution.

Discriminative

- Given a sample, determines if it comes from a distribution

- Input: a sample

- Output:
    - True/False,
    - a class label, etc.
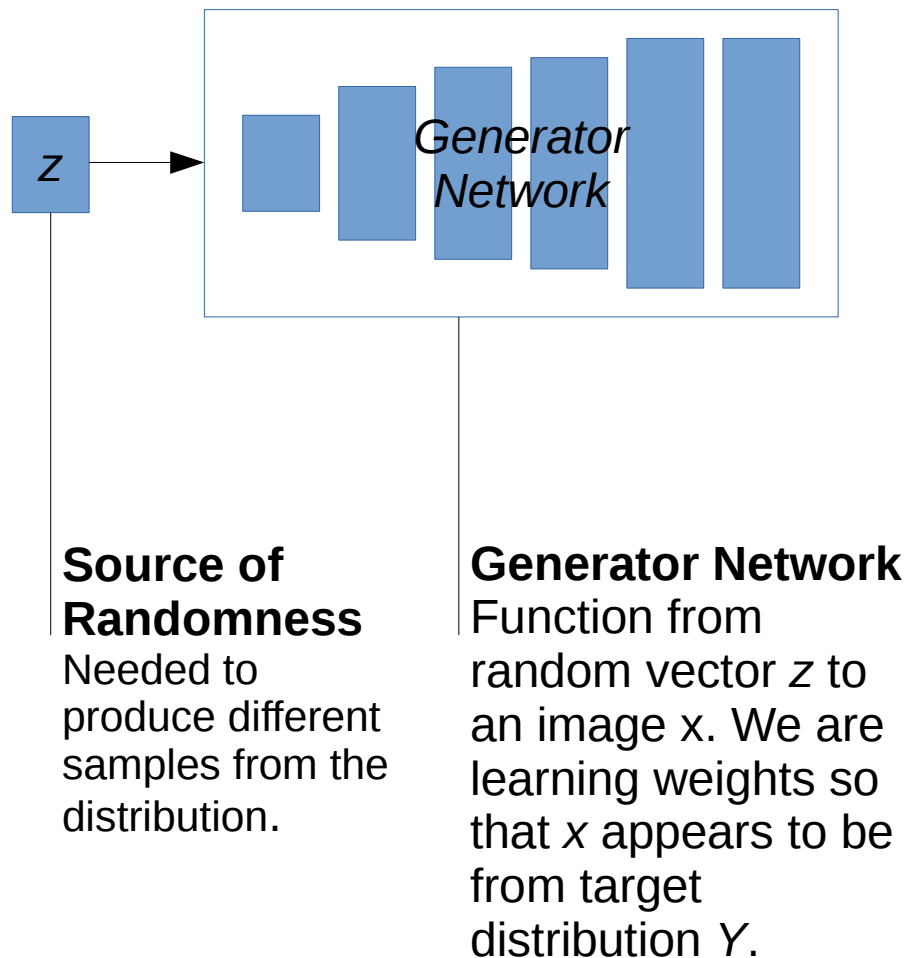
Training a Generative Model

Generative

- Data
  - (Image, Label)
  - (Image, Label)
  - ...

- Label -> Image
  - *Not a function!*
  - It is a *distribution*.
  - One-to-many relationship.
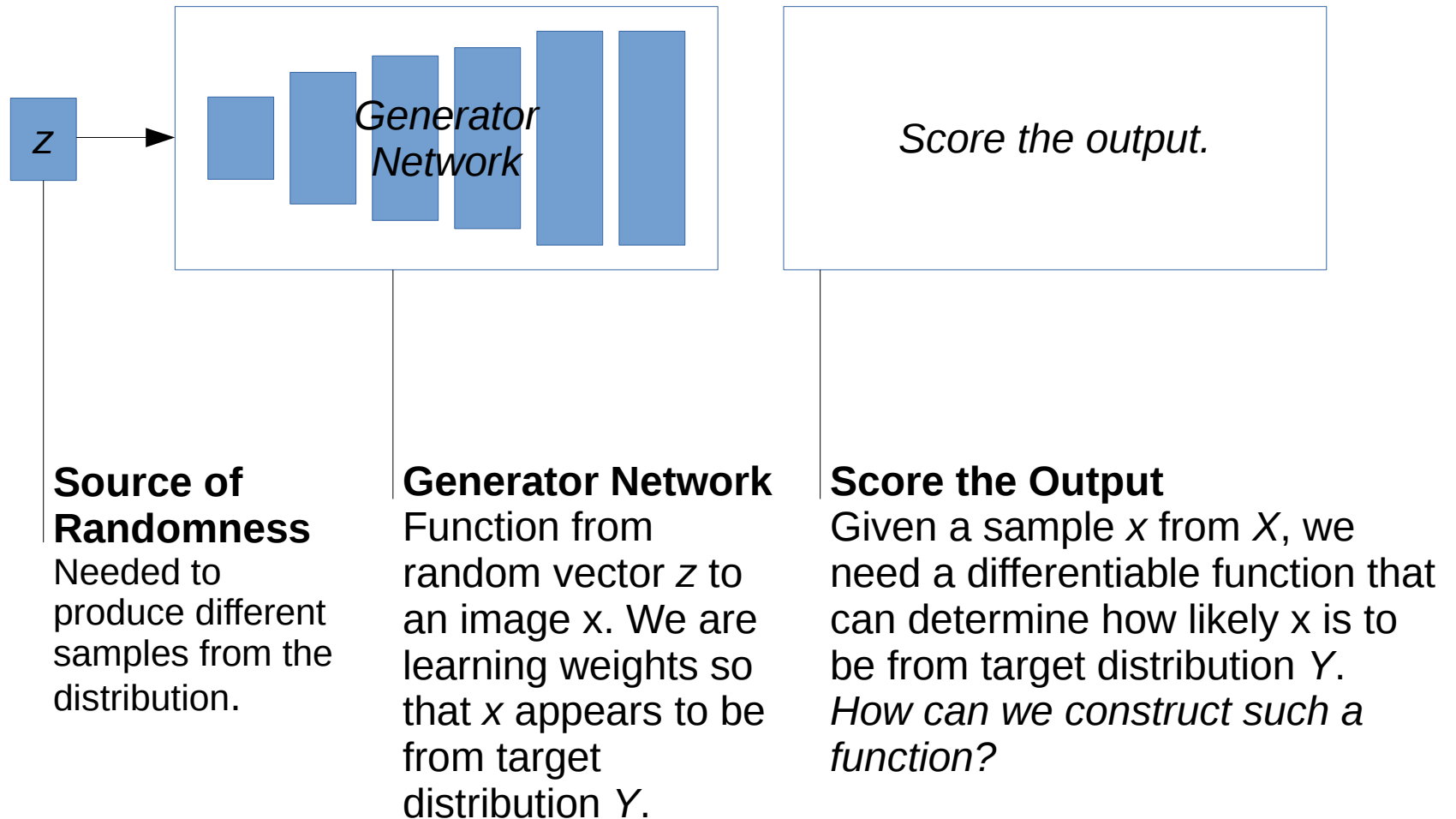
Discriminative

- Data
  - (Image, Label)
  - (Image, Label)
  - ...

- Image -> Label
  - Non-bijective function.
  - SGD to learn function.

Make the Generator a Function

z

Generator Network

Source of Randomness
Needed to produce different samples from the distribution.

Generator Network
Function from random vector *z* to an image x. We are learning weights so that *x* appears to be from target distribution *Y*.

Score the output

z

Generator Network

Score the output.

Source of Randomness
Needed to produce different samples from the distribution.

Generator Network
Function from random vector z to an image x. We are learning weights so that x appears to be from target distribution Y.

Score the Output
Given a sample x from X, we need a differentiable function that can determine how likely x is to be from target distribution Y.
How can we construct such a function?

The Discriminator Network

z

Generator Network

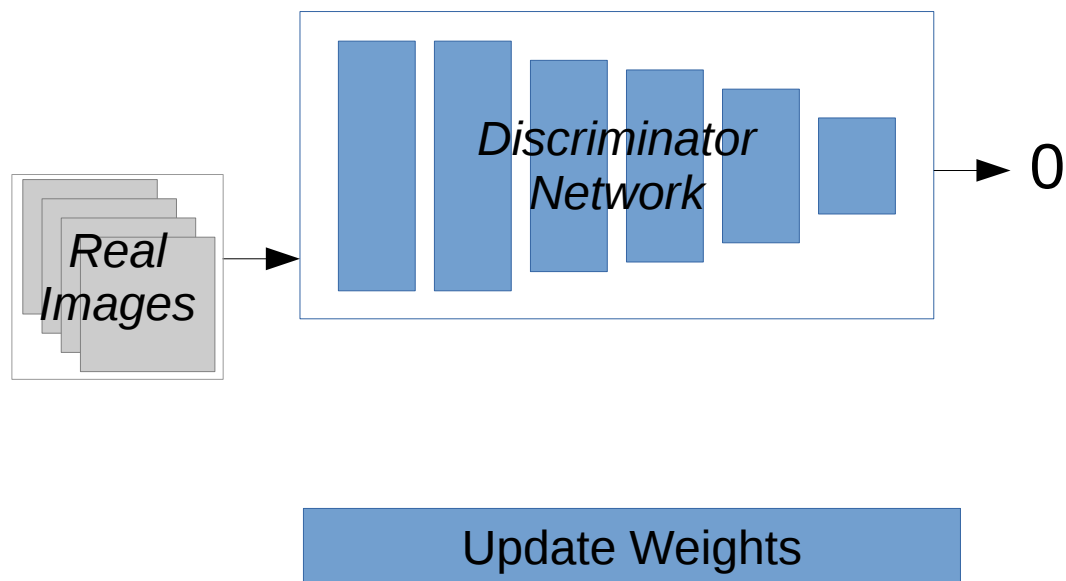*Real Images*

Discriminator Network

0

Real Images
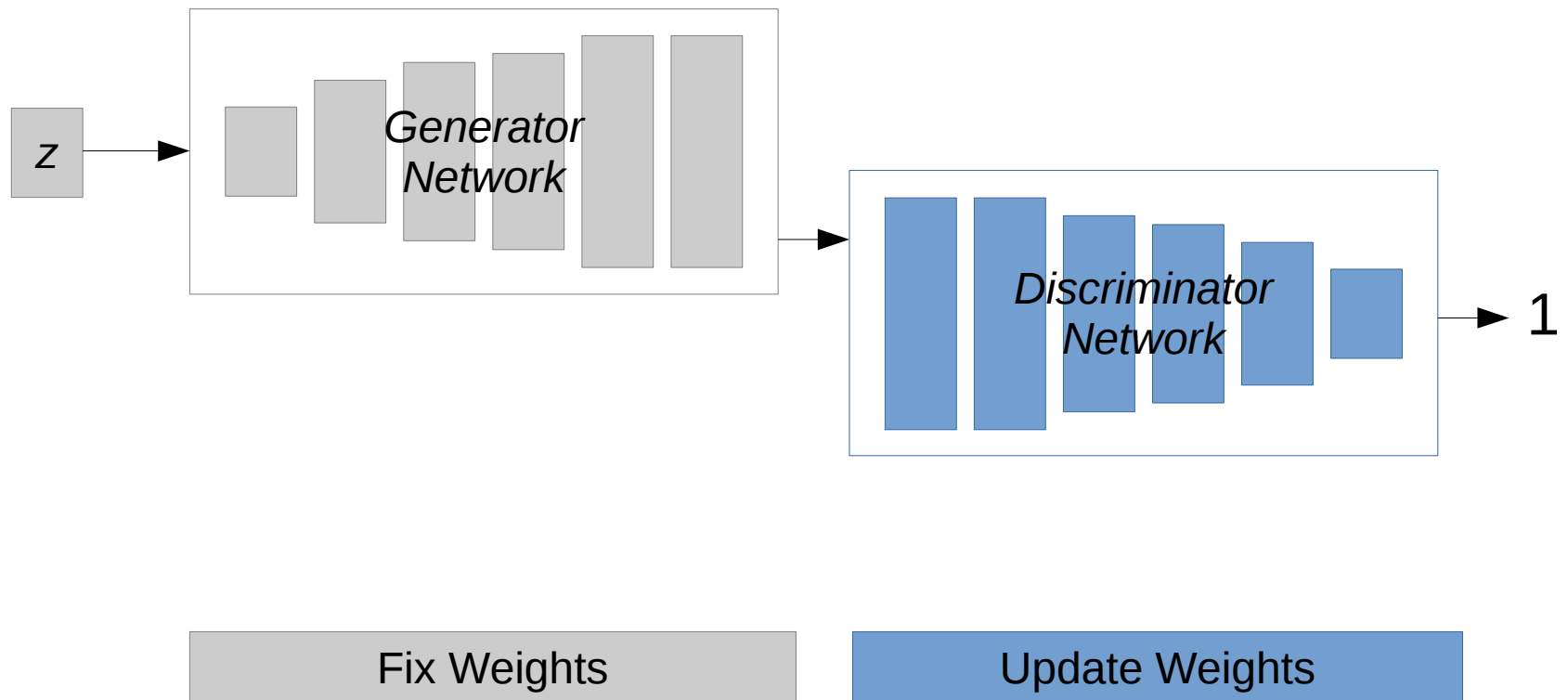Samples from distribution Y

Discriminator Network
Returns 1 if the input image is from *X* (generator output distribution), and 0 if it is from *Y* (real image distribution).

Training the Network (1/3)

Training the Network (2/3)

Training the Network (3/3)

z → Generator Network → Discriminator Network → 0

Update Weights

Fix Weights