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

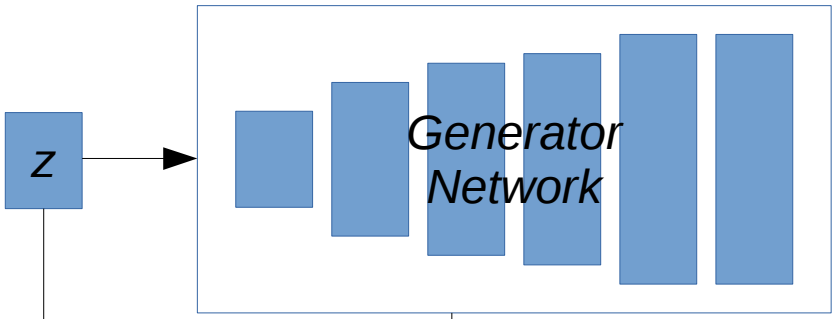
Generative

- 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.

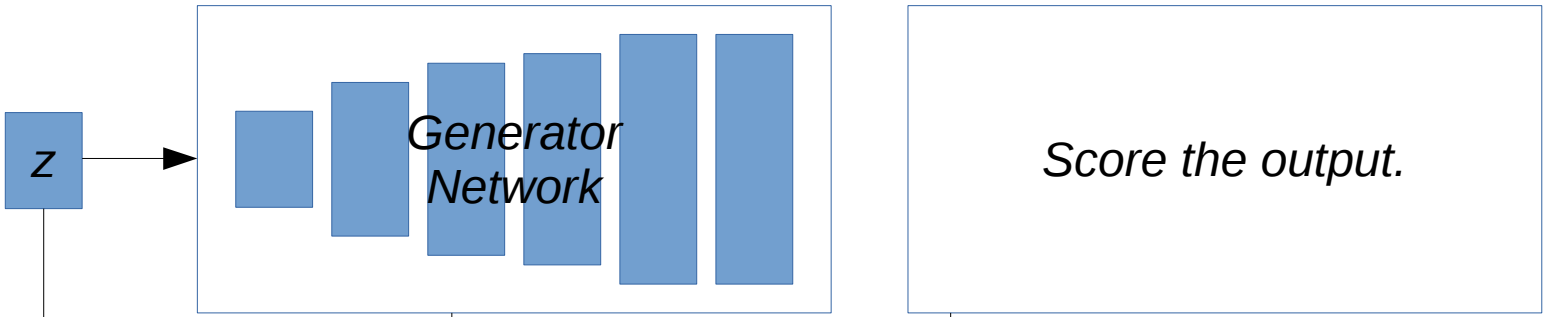
Make the Generator a Function



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

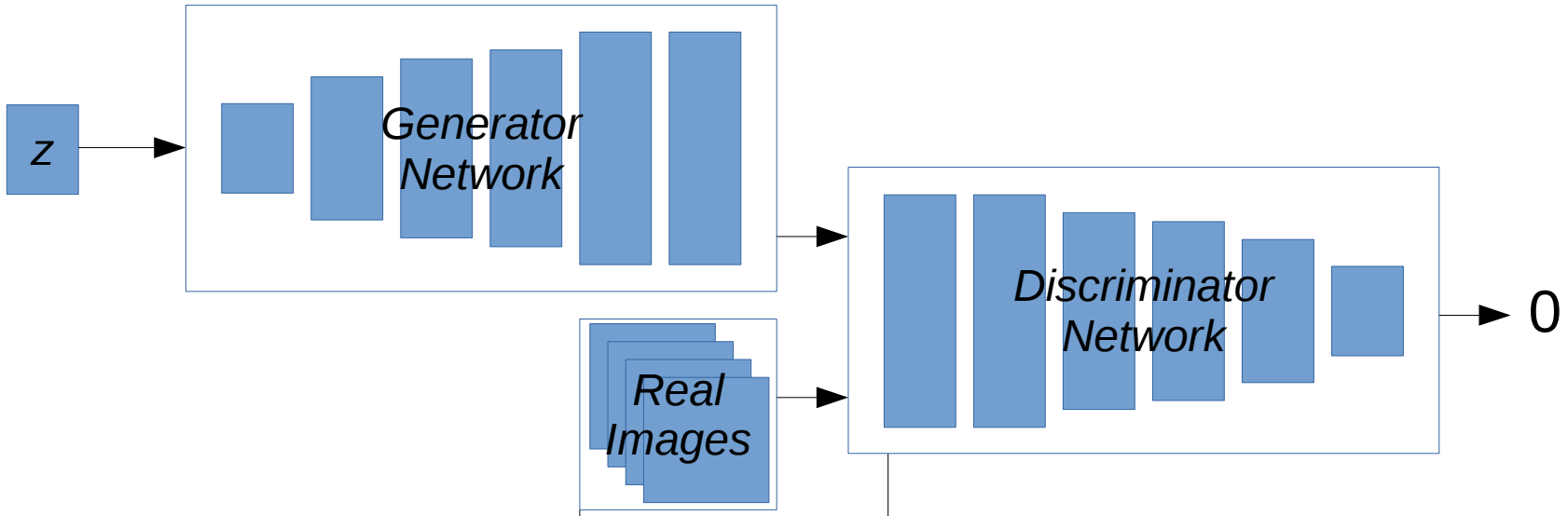


Source of Randomness
Needed to produce different samples from the distribution.

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?

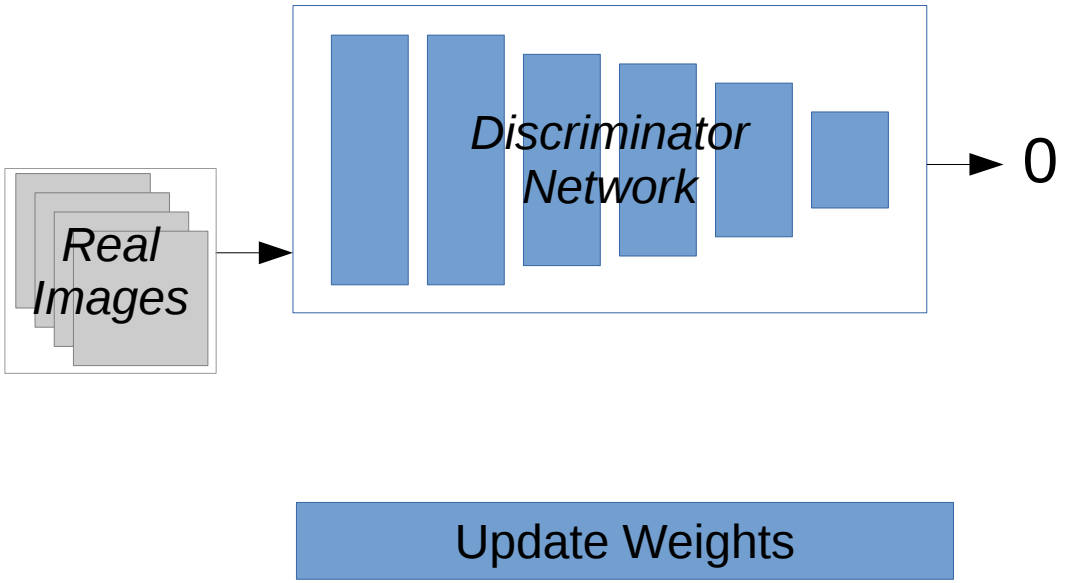
The Discriminator Network



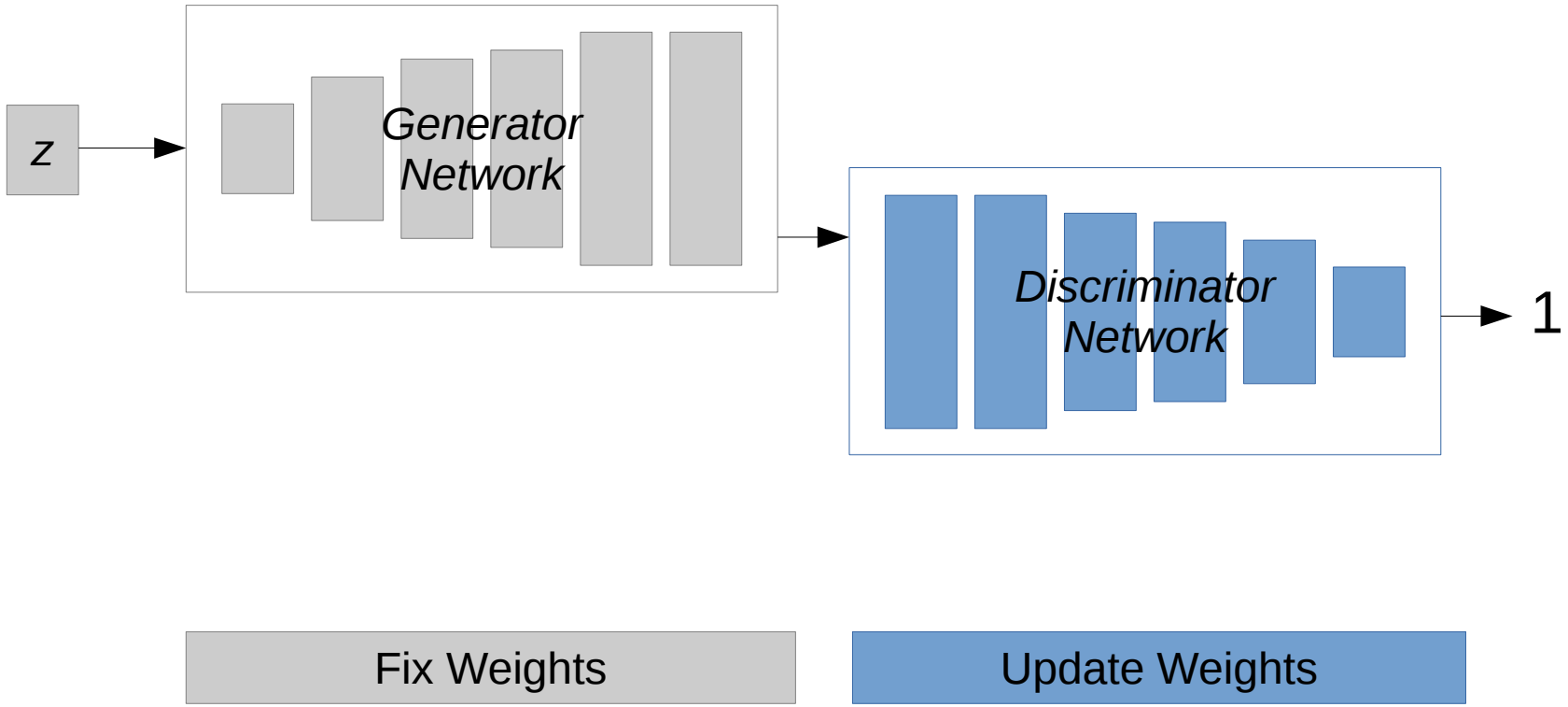
Real Images
Samples from distribution Y

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

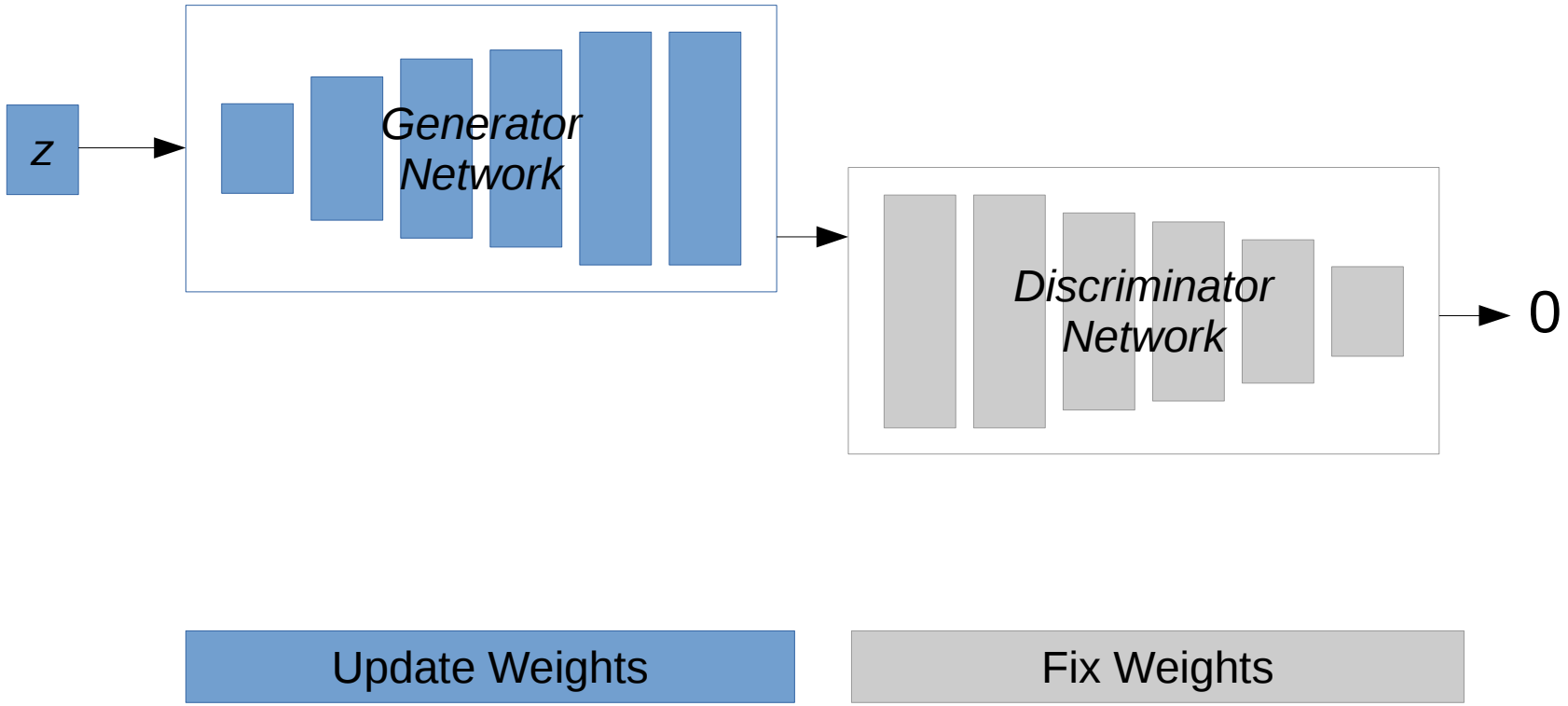
Training the Network (1/3)



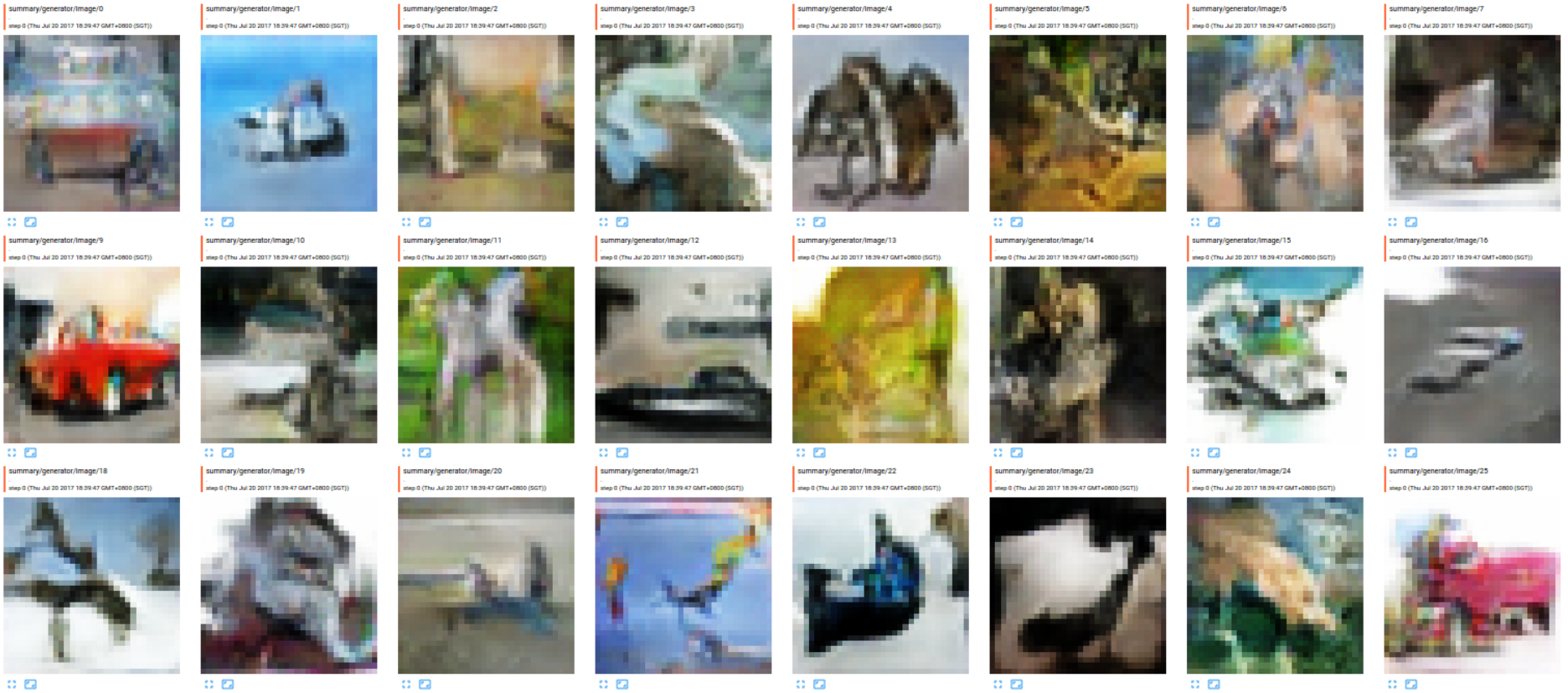
Training the Network (2/3)



Training the Network (3/3)



Output!


summary/generator/Image/0
summary/generator/Image/1
summary/generator/Image/2
summary/generator/Image/3
summary/generator/Image/4
summary/generator/Image/5
summary/generator/Image/6
summary/generator/Image/7
summary/generator/Image/9
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Comparing Output