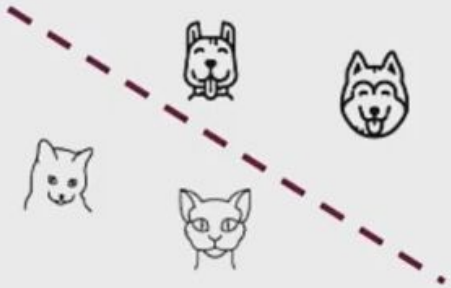


# Generative Adversarial Networks

GANs

# Discriminative vs Generative

## Discriminative models



Features      Class

$$X \rightarrow Y$$

$$P(Y|X)$$

## Generative models

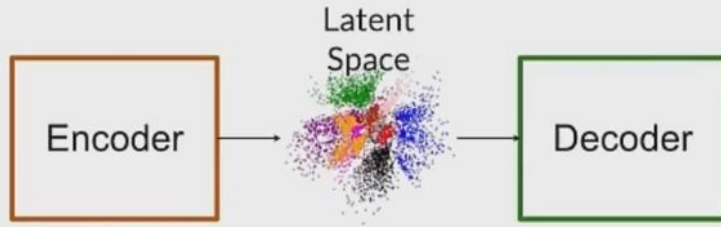


Noise    Class      Features

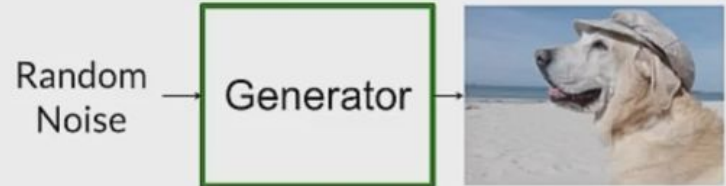
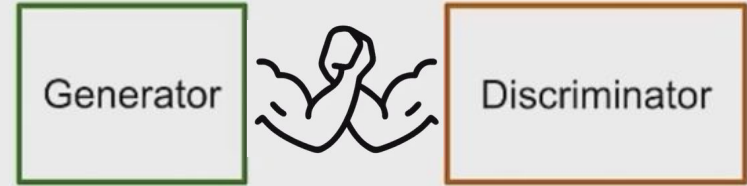
$$\xi, Y \rightarrow X$$

# Generative Models

## Variational Autoencoders

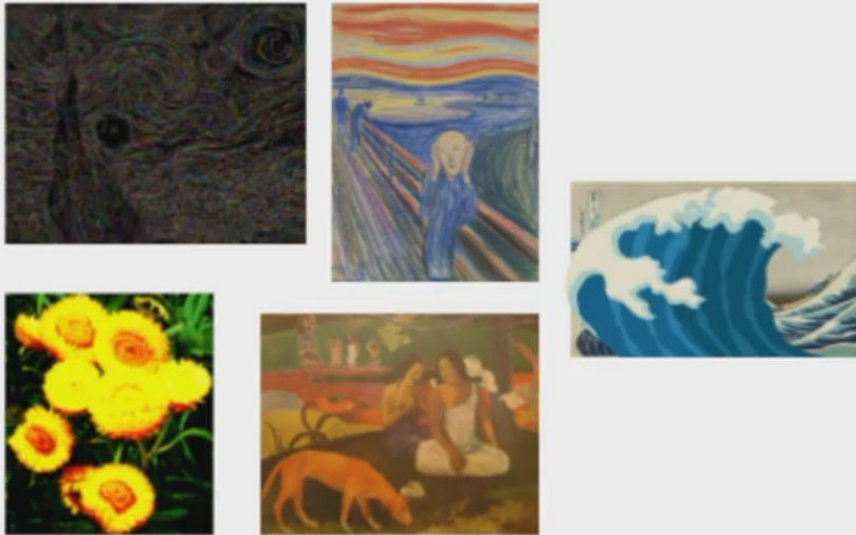


## Generative Adversarial Networks

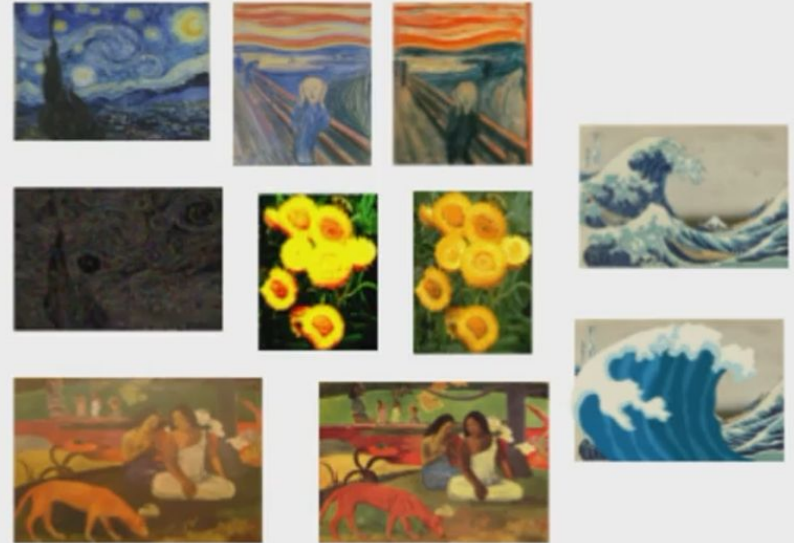


# The Competition Between Generator and Discriminator

Generator learns to make *fakes*  
that look *real*



Discriminator learns to distinguish  
*real* from *fake*



# Discriminator

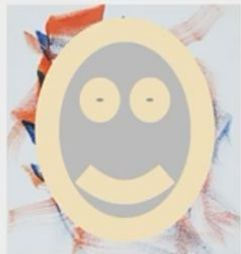
Discriminator learns to distinguish  
real from fake



# The Game Is On!



5% Real



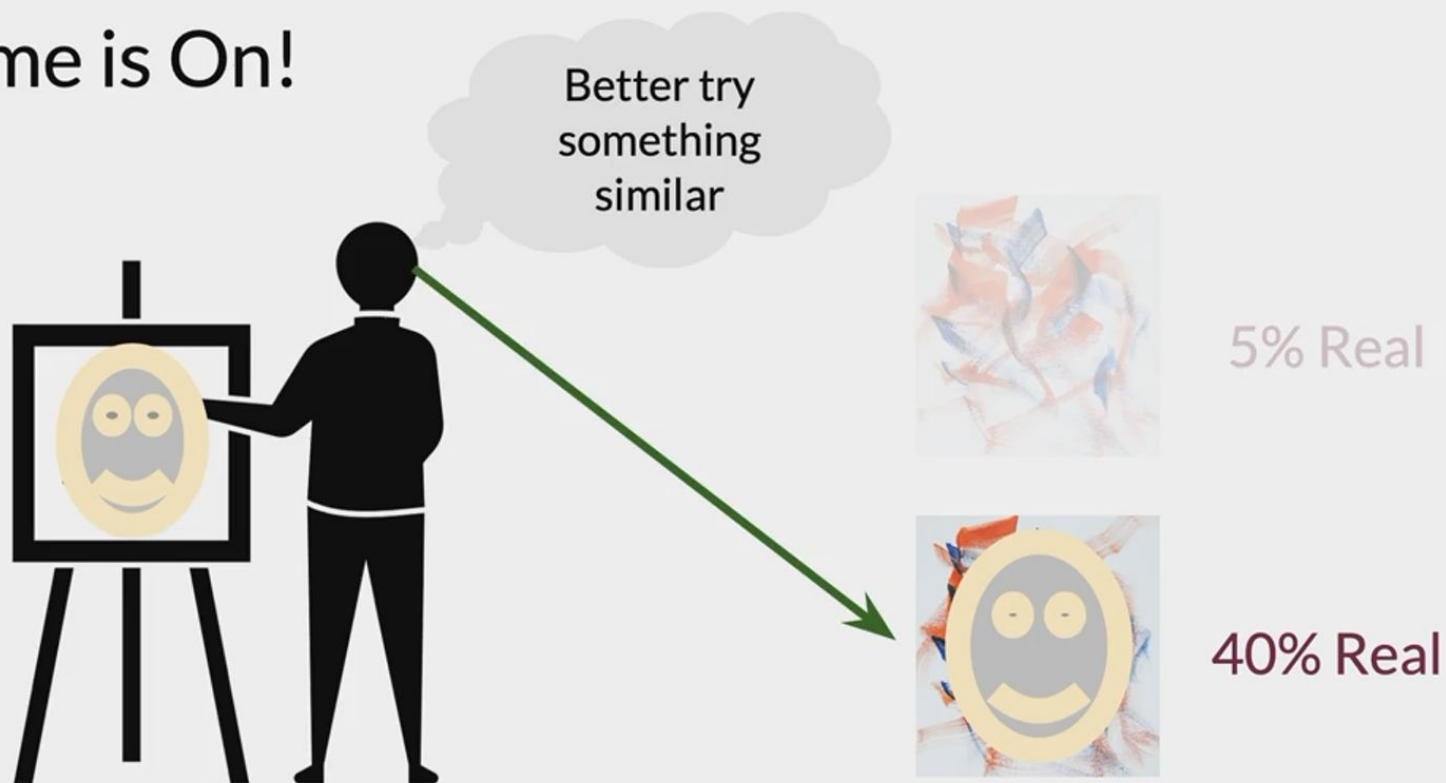
40% Real



80%  
Real



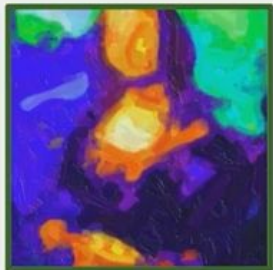
# The Game is On!



# The Game Is On!



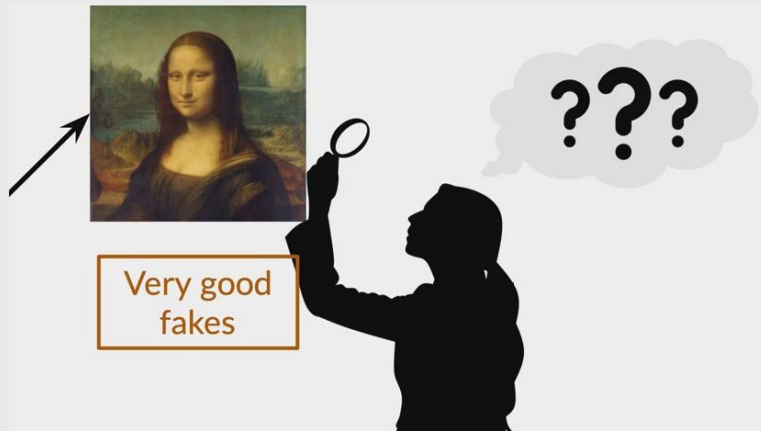
30% Real



60% Real



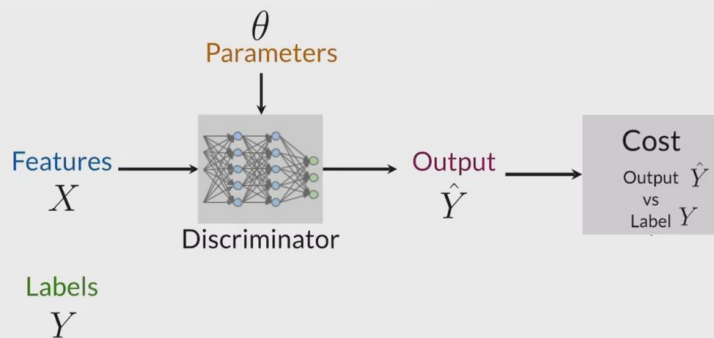
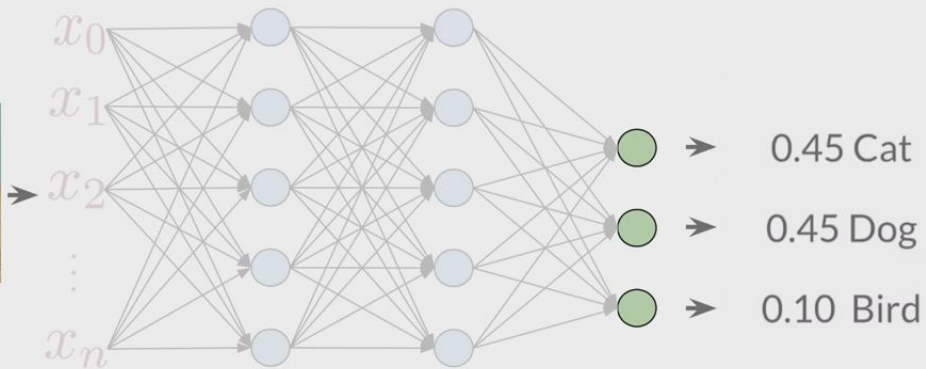
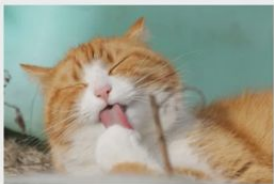
95% Real





# Discriminator

Classifier



Turtle

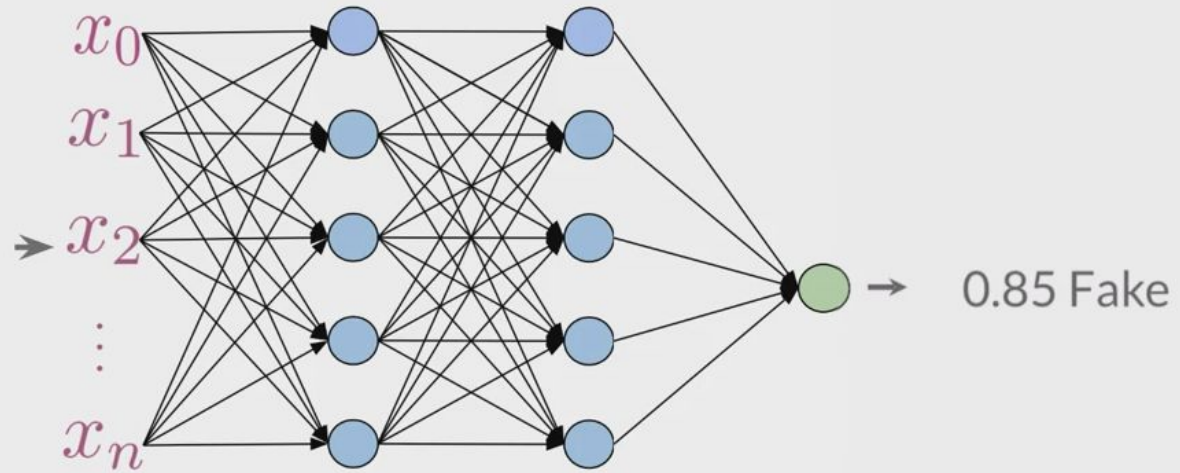
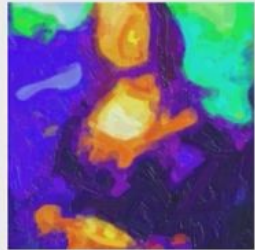
$$P(Y | X)$$

Class

Features

Fish

# Discriminator



# Discriminator

$$P(\text{Fake Class} \mid \text{Features})$$


# Generator

Turtle

Generates examples of the class

Bird

Cat

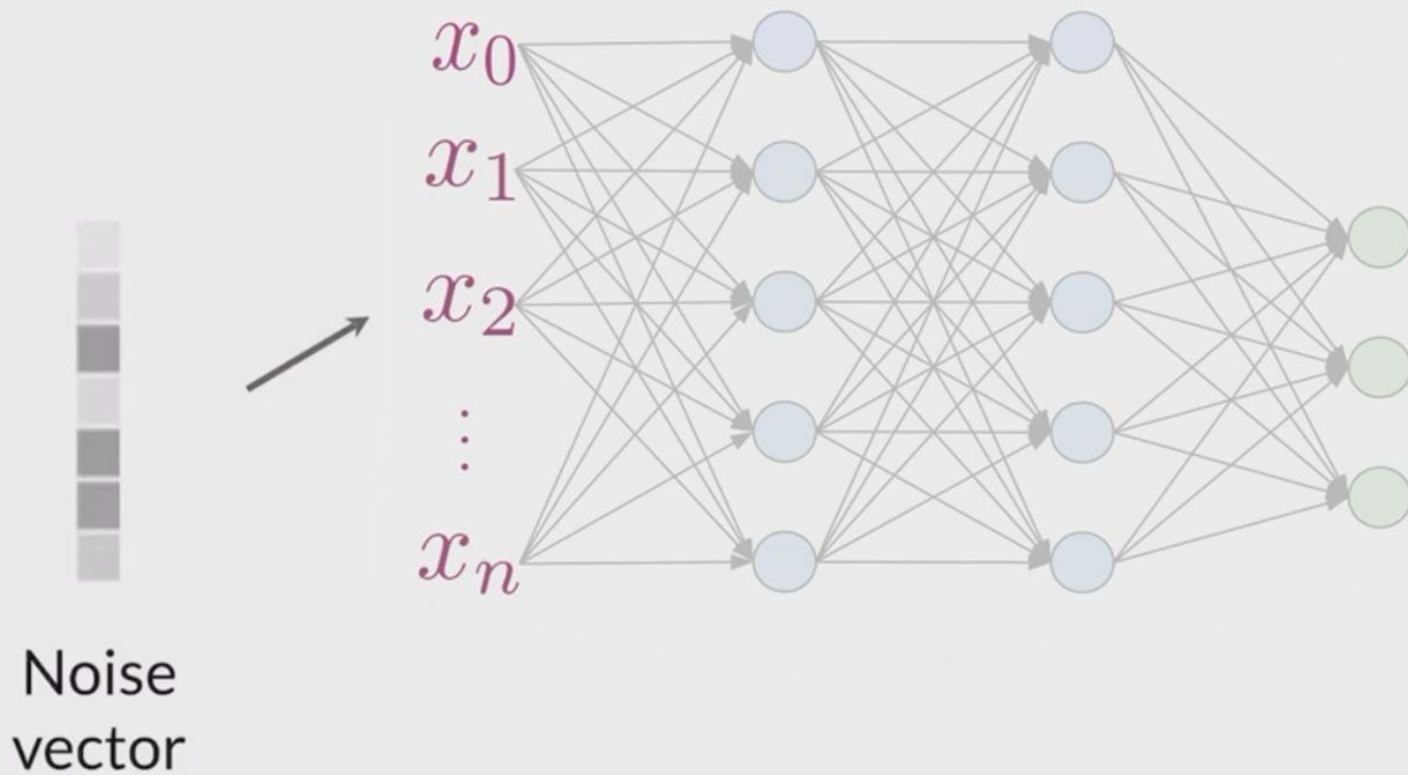
Dog

Fish

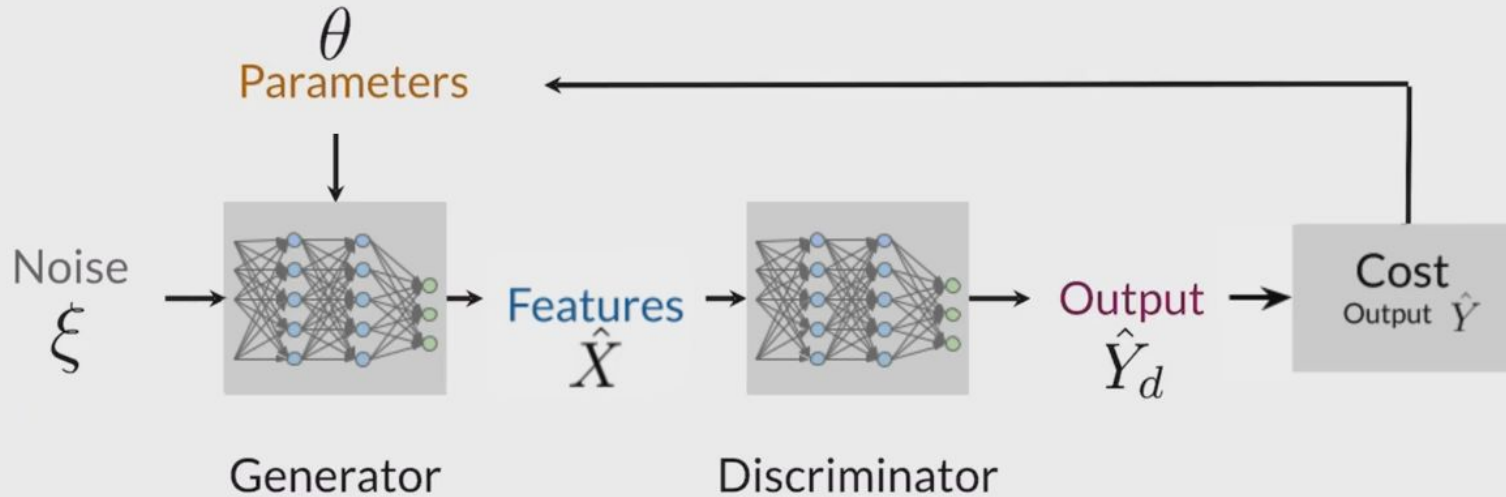
Generator



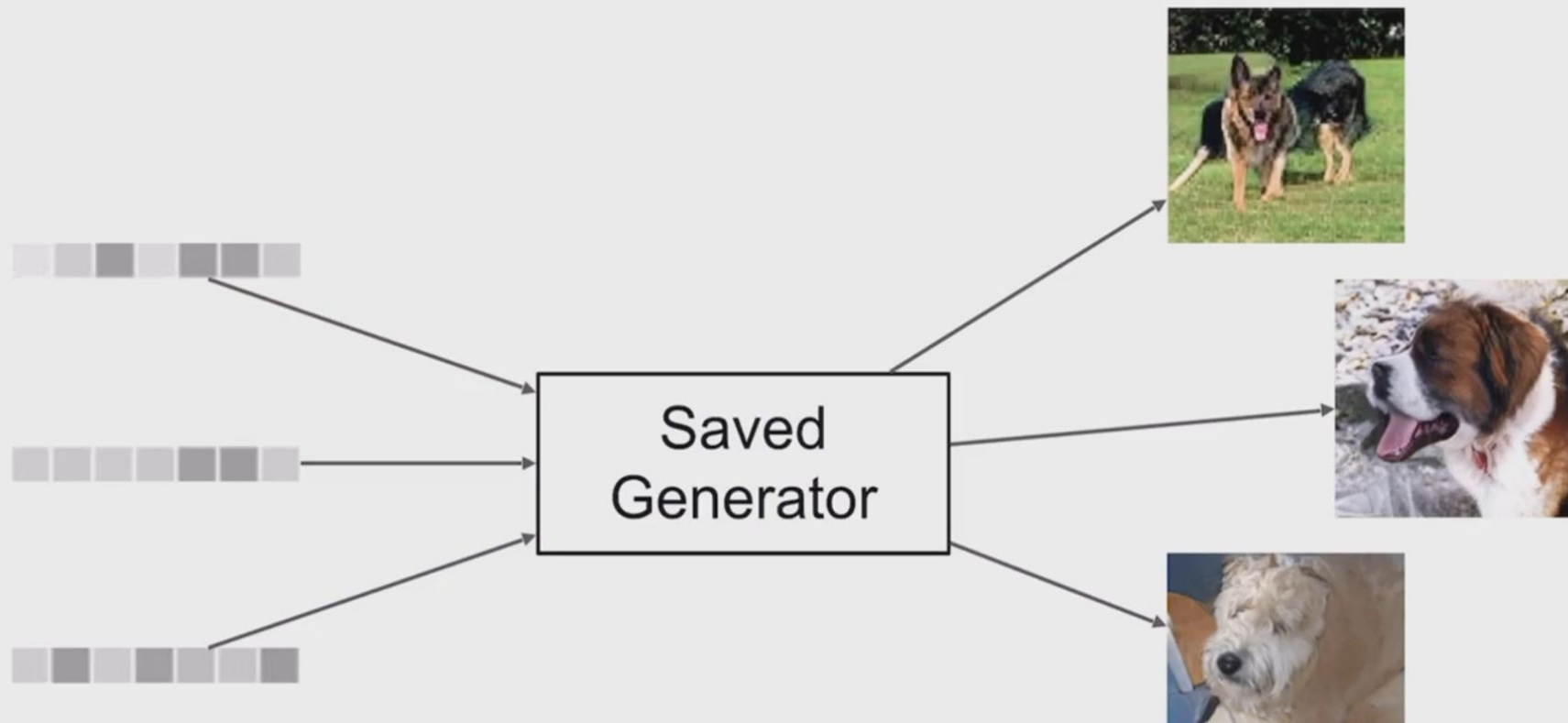
# Generator



# Generator Learning



# Sampling



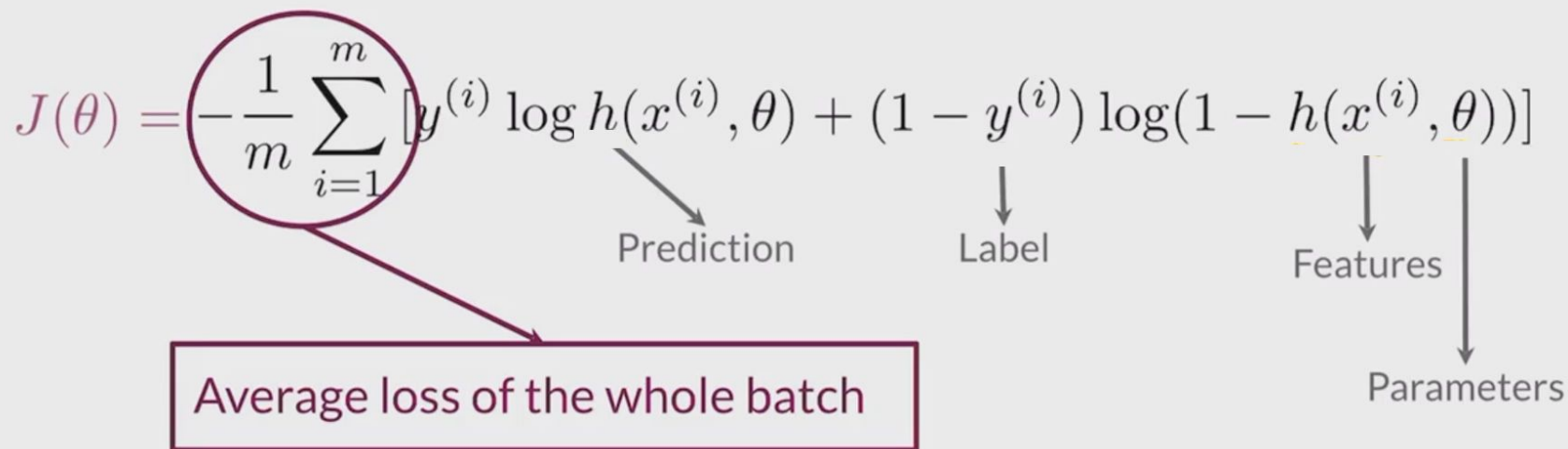


# Generator

$$P(\underset{\text{Features}}{X} \mid \underset{\text{Class}}{Y})$$

# BCE Loss Function

$$J(\theta) = -\frac{1}{m} \sum_{i=1}^m [y^{(i)} \log h(x^{(i)}, \theta) + (1 - y^{(i)}) \log(1 - h(x^{(i)}, \theta))]$$



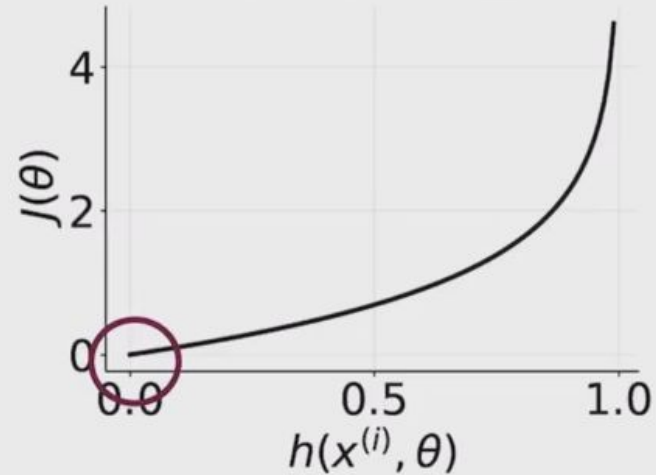
# BCE Loss Function (Binary Cross Entropy)

$$J(\theta) = -\frac{1}{m} \sum_{i=1}^m [y^{(i)} \log h(x^{(i)}, \theta) + (1 - y^{(i)}) \log(1 - h(x^{(i)}, \theta))]$$

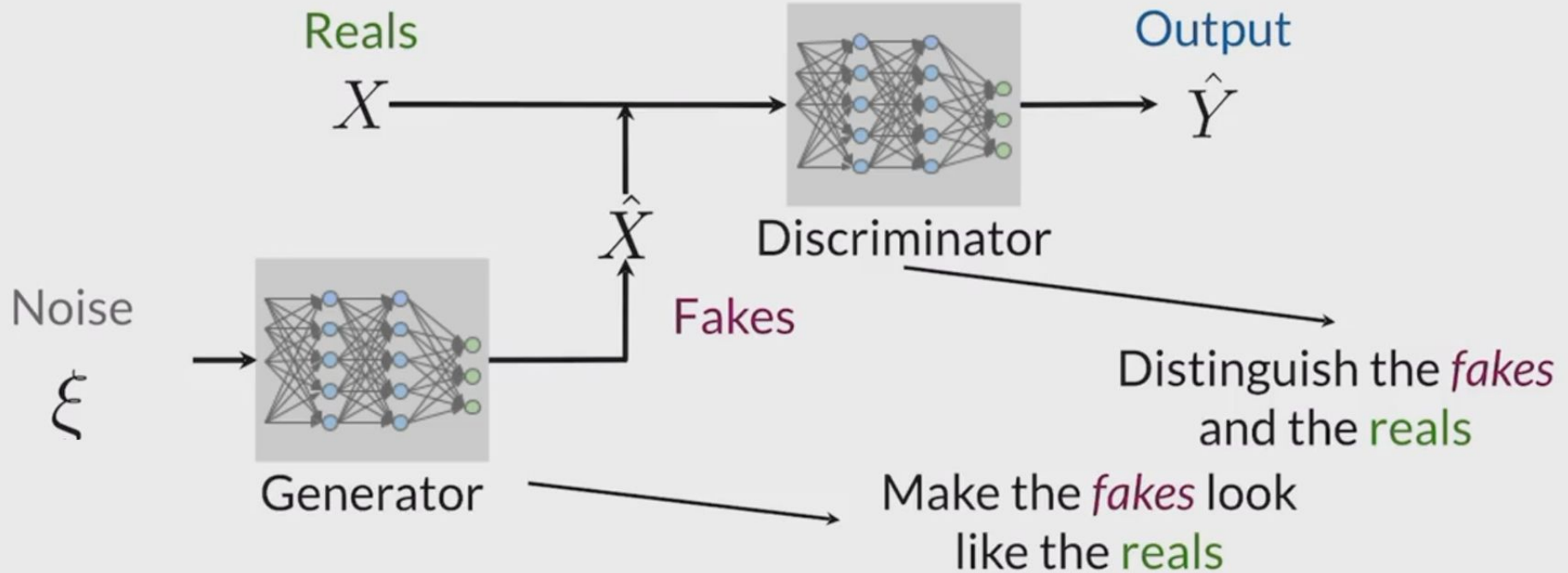
$y^{(i)} \quad h(x^{(i)}, \theta) \quad | \quad (1 - y^{(i)}) \log(1 - h(x^{(i)}, \theta))$

# BCE Loss Function

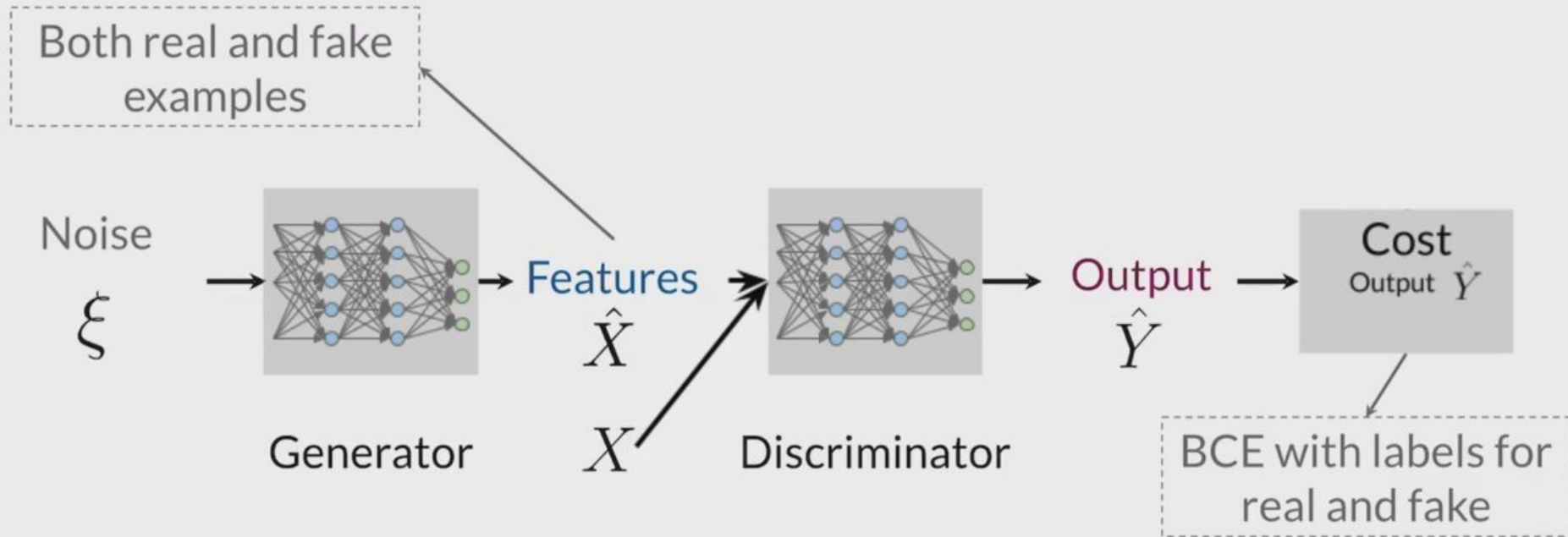
$$J(\theta) = -\frac{1}{m} \sum_{i=1}^m [y^{(i)} \log h(x^{(i)}, \theta) + (1 - y^{(i)}) \log(1 - h(x^{(i)}, \theta))]$$



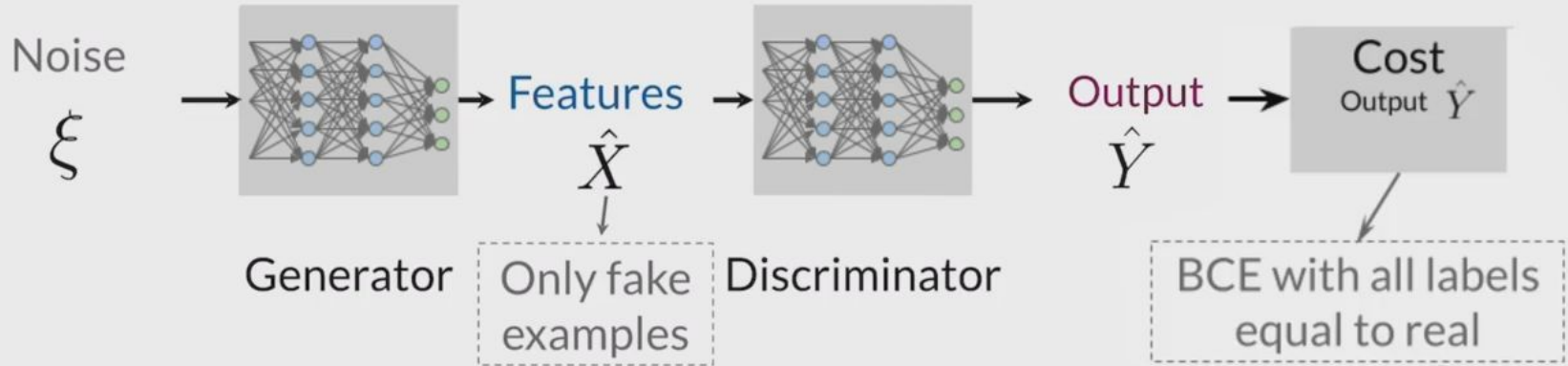
# GANs Model



# Training GANs : Discriminator



# Training GANs : Generator



# Training GANs

