

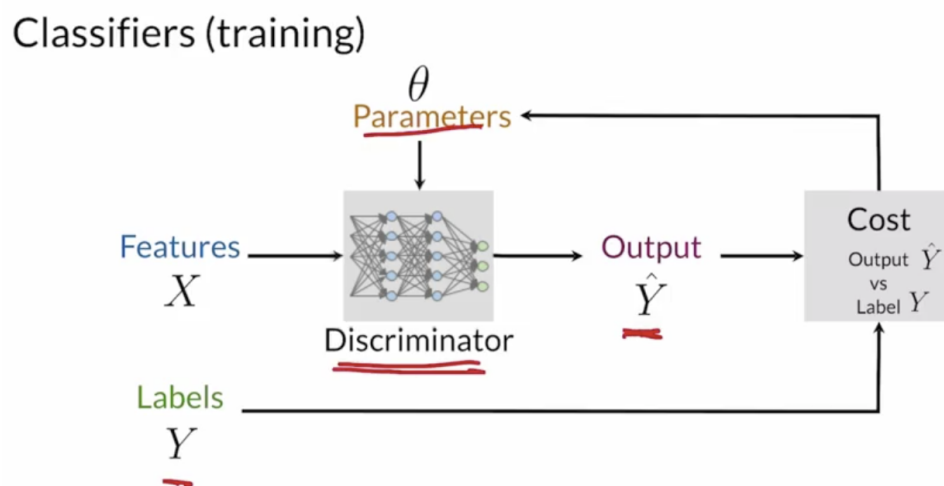
# Week 1 - Intro to GAN

## Intuition Behind GANs

### Generative Adversarial Network

- **Generator** learns to make *fakes* that look *real*
- **Discriminator** learns to distinguish *real* from *fake*

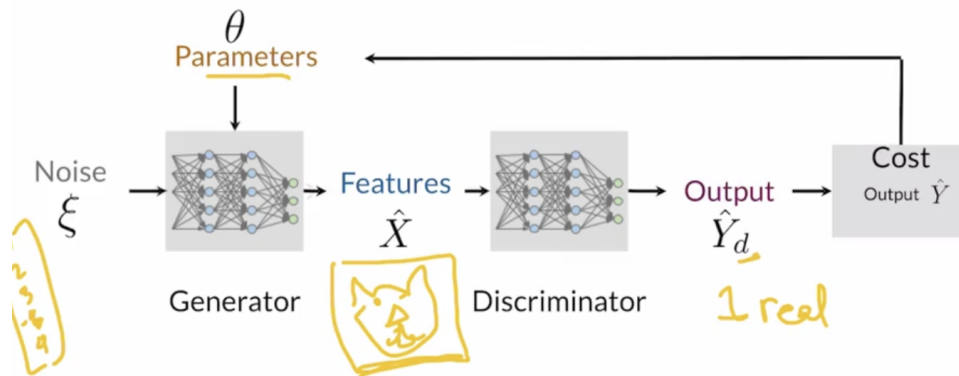
### Discriminator



- The **discriminator** is a classifier
- It learns the probability of class  $Y$  (*real* or *fake*) given feature  $X$
- The probabilities are the feedback for the **generator**

### Generator

## Generator: Learning



- The **generator** produces fake data
- It learns the probability of features  $X$
- The **generator** takes as input **noise**(random features)

## BCE(Binary Cross Entropy) Cost Function

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

- $x^{(i)}$  : features,  $y^{(i)}$  : Label,  $\theta$  : parameters
- $h()$  : prediction

### $y(i) \log h(x(i), \theta)$

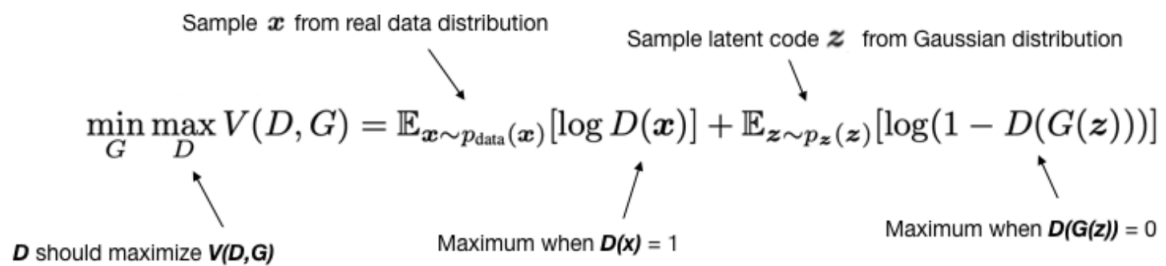
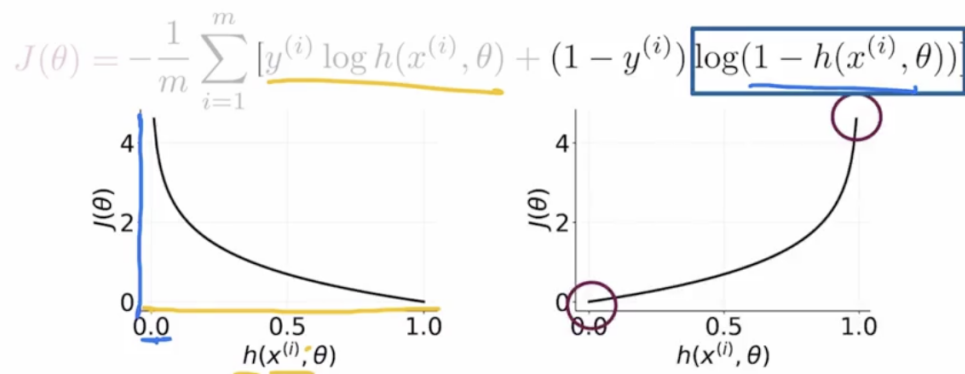
Aa Name	$y(i)$	$h(x(i), \theta)$	$y(i) \log h(x(i), \theta)$
Untitled	0	any	0
Untitled	1	0.99	$\sim 0$
Untitled	1	$\sim 0$	$-\infty$

### $(1-y(i)) \log(1-h(x(i), \theta))$

Aa Name	$y(i)$	$h(x(i), \theta)$	$(1-y(i)) \log(1-h(x(i), \theta))$
Untitled	1	any	0
Untitled	0	0.01	$\sim 0$
Untitled	0	$\sim 1$	$-\infty$

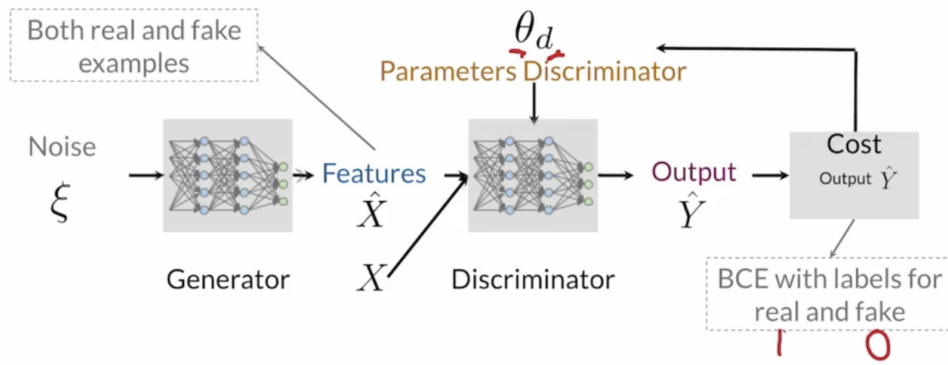
- The BCE cost function has two parts (one relevant for each class)
- Close to zero when the label and the prediction are similar
- Approaches infinity when the label and the prediction are different

## BCE Cost Function



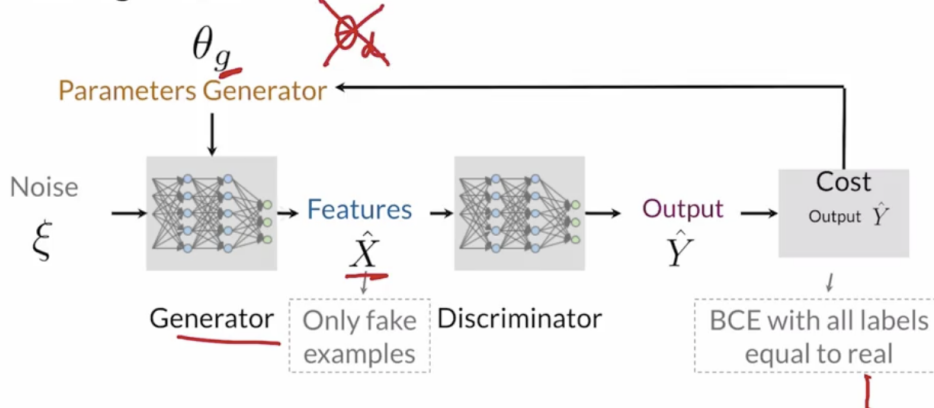
## Putting It All Together

## Training GANs: Discriminator



The discriminator learns to recognize the real image as real, and the fake image as fake.

## Training GANs: Generator



When training a Generator, it is important to freeze the weights of the discriminator so that only the weights of the Generator are updated. Otherwise, the Generator's image can be adjusted to be true. The generated image should be predicted to be close to 1 (real image), not because the discriminator is weak, but because the Generator is strong.

- Reference

- <https://www.coursera.org/specializations/generative-adversarial-networks-gans>
- <https://velog.io/@hwany/GAN>