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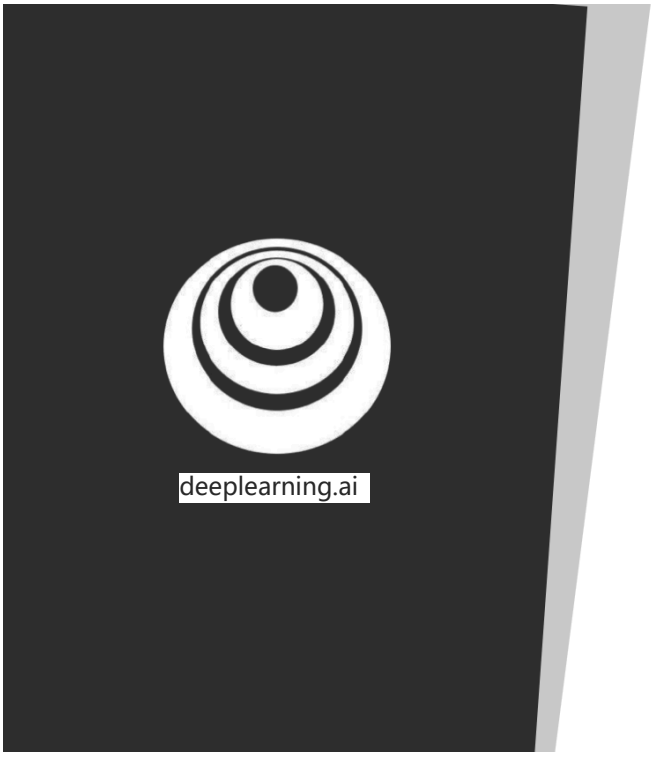

生成模型

大纲

- 什么是生成模型
- 生成模型的类型

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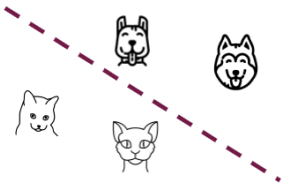
生成模型与判别模型

判别模型



特征 类

$$X \rightarrow Y$$

$$P(Y|X)$$

生成模型

噪声 类 特征

$$\xi, Y \rightarrow X$$

$$P(X|Y)$$

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生成模型与判别模型

生成模型

噪声 类 特征

$$\xi, Y \rightarrow X$$

$$P(X|Y)$$

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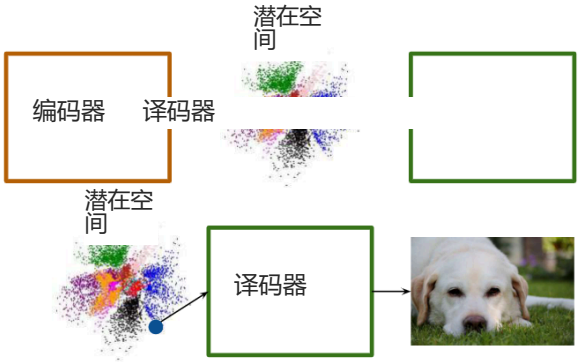
生成模型

变分自动编码器

生成对抗网络



可从： https://arxiv.org/abs/1804.00891

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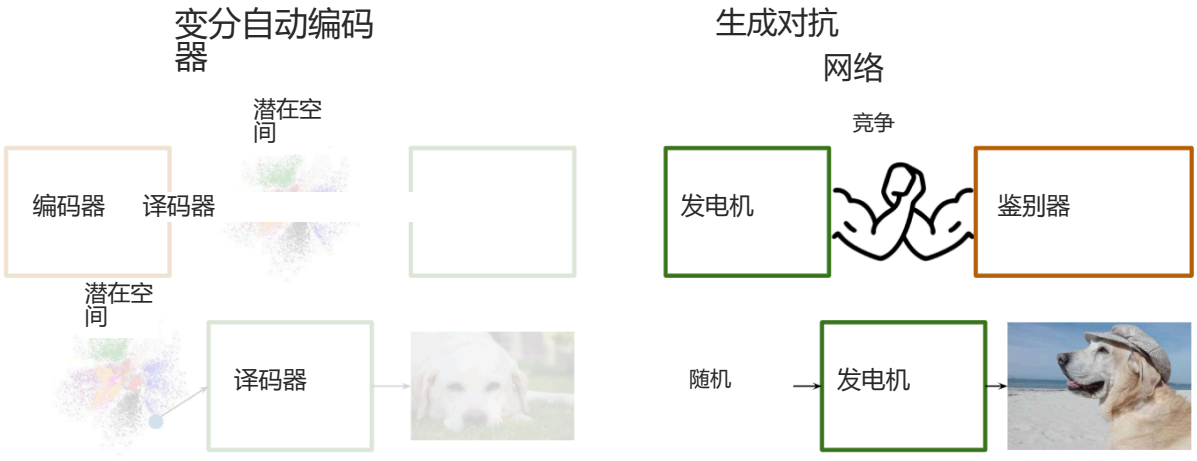
生成模型



可从： https://arxiv.org/abs/1804.00891

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总结

- 生成模型学习生成示例
- 判别模型区分类
- 接下来，GAN!

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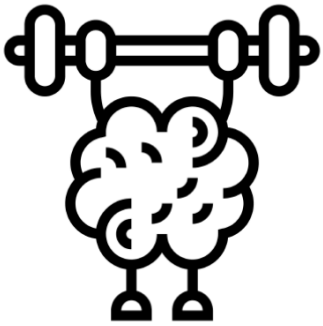
现实生活中的 GAN

大纲

- GAN 的酷应用
- 使用它们的大公司



GANs 随时间的变化

2014 黑色和白色

↓

2018 彩色照片写实

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GANs 随时间的变化

人脸生成样式 GAN2

这些人会不存在!

Karras， Tero， et al. “分析和提高 stylegan 的图像质量。” 计算机视觉和模式识别 IEEE/CVF 会议论文集。2020.

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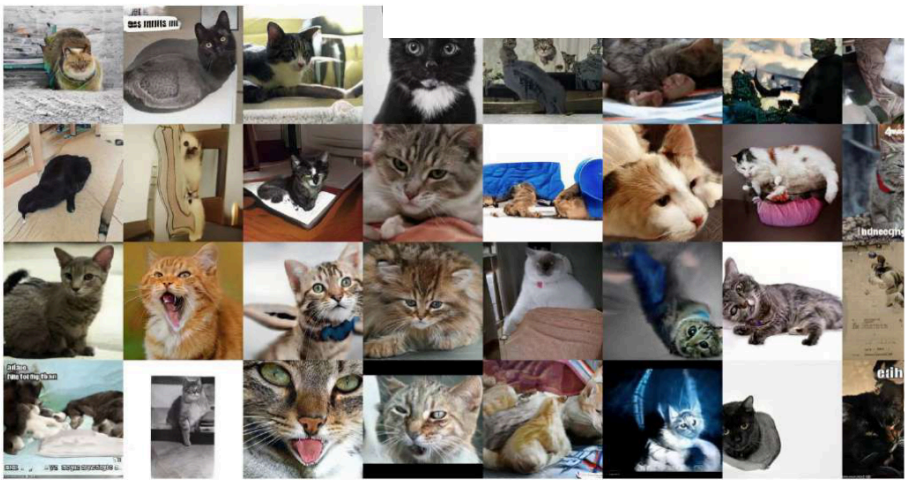
GANs 随时间的变化 样式GAN2



模拟训练数据的分布

Karras， Tero， et al. “分析和提高 stylegan 的图像质量。” 计算机视觉和模式识别 IEEE/CVF 会议论文集。2020. https://9gag.com/gag/aWYZKWx

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用于图像翻译的 GAN

从一个域到另一个域

循环甘

Park， Taesung， et al. “具有空间自适应归一化的语义图像合成。” IEEE 计算机视觉和模式识别会议论文集。2019.

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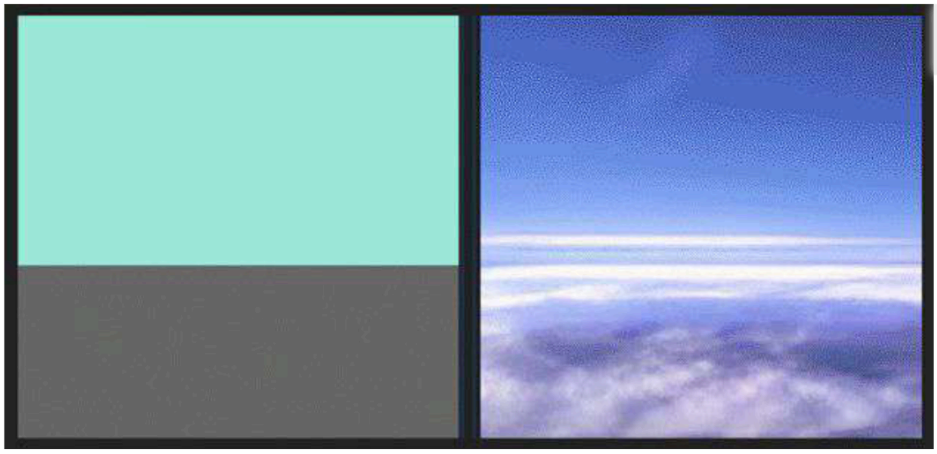
用于图像翻译的 GAN



Park， Taesung， et al. “具有空间自适应归一化的语义图像合成。” IEEE 计算机视觉和模式识别会议论文集。2019.

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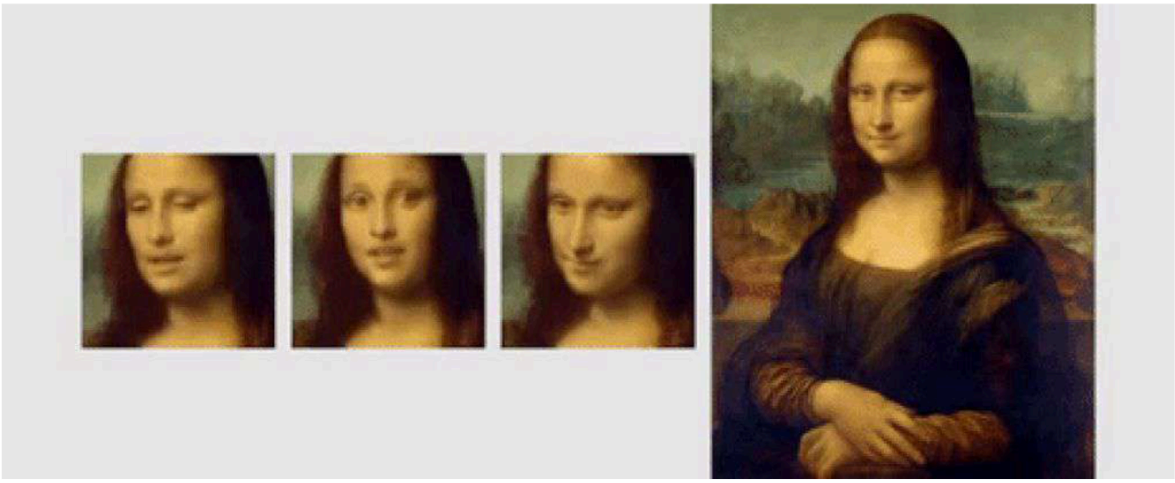
GAN 就是魔法!



Zakharov， Egor， et al. “现实神经说话头模型的少镜头对抗性学习。” IEEE 计算机视觉国际会议论文集。2019.

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用于 3D 对象的 GAN

3D-GAN

生成
设计

Wu， Jiajun， et al. “通过 3D 生成-对抗建模学习对象形状的概率潜在空间。” 神经信息处理系统的进步。2016.

使用 GAN 的公司

Adobe 下一代 Photoshop

Google 文本生成

IBM 数据增强

图像过滤器

Disney 超分辨率

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总结

- GAN 的性能正在迅速提高
- 在这个领域工作的巨大机会!
- 大公司正在使用它们

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GAN 背后的直觉

大纲

- 生成器和判别器的目标
- 他们之间的竞争

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生成对抗网络

Generator 学会造假
那个看起来真的

判别器学会区分
真假

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生成对抗网络

Generator 学会造假
那个看起来真的

假

真正

判别器学会区分
真假

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生成对抗网络

Generator 学会造假
那个看起来真的

判别器学会区分
真假

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生成对抗网络

Generator 学会造假
那个看起来真的

不知道怎么做
它应该看起来

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生成对抗网络

判别器学会区分
真假

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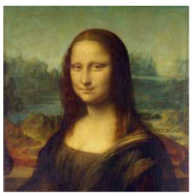
游戏开始了！

5% 真实

40% 真实



80% 真实

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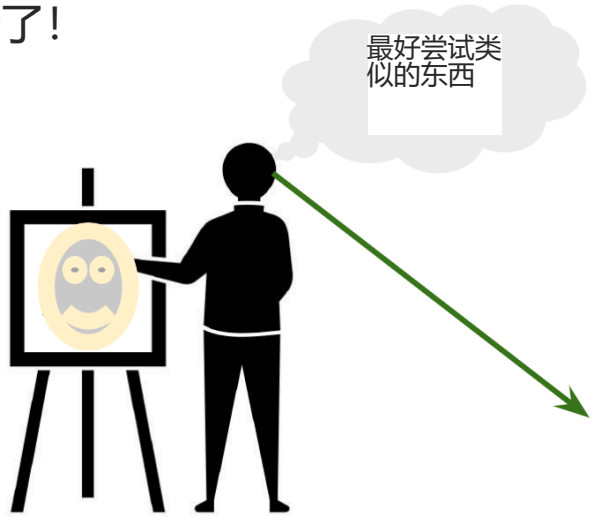
游戏开始了！



5% 真实

40% 真实

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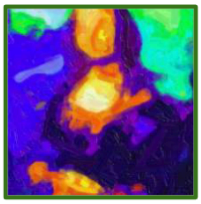
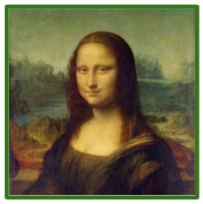
游戏开始了！

30% 真实



60% 真实



95% 真实

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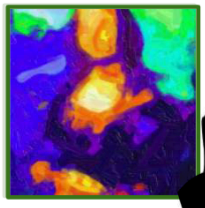
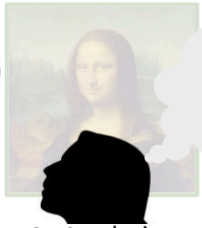
游戏开始了！

30% 真实



60% 真实

错！



95% 真实

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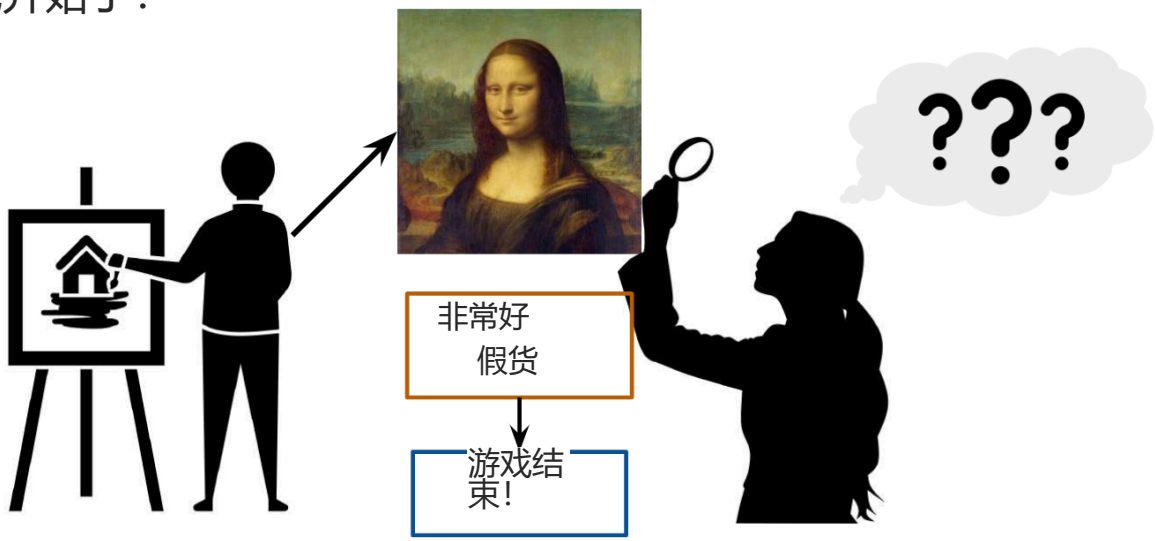
游戏开始了！



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总结

- 生成器的目标是欺骗判别器
- 判别器的目标是区分真假
- 他们从竞争中相互学习
- 到头来，假货看起来是真的

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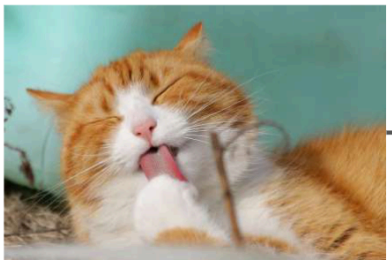
鉴别器

大纲

- 分类器回顾
- 分类器在概率方面的作用
- 鉴别器

分类

区分不同的类



分类

海龟

鸟

猫

狗

鱼

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分类

区分不同的类

“它喵喵叫，嬉戏纱线”

分类

海龟

鸟

猫

狗

鱼

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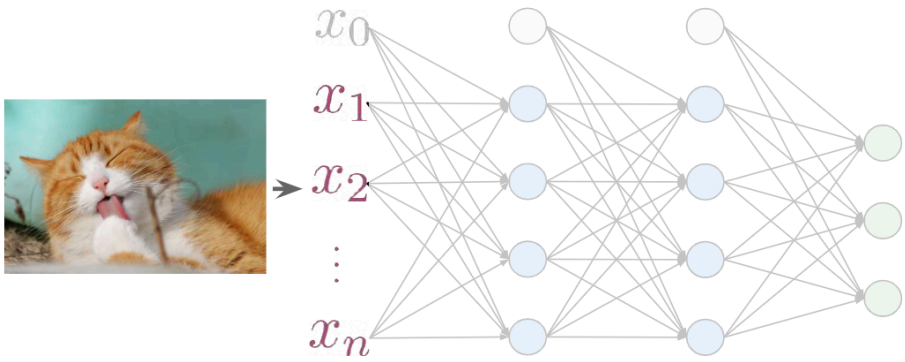
神经网络



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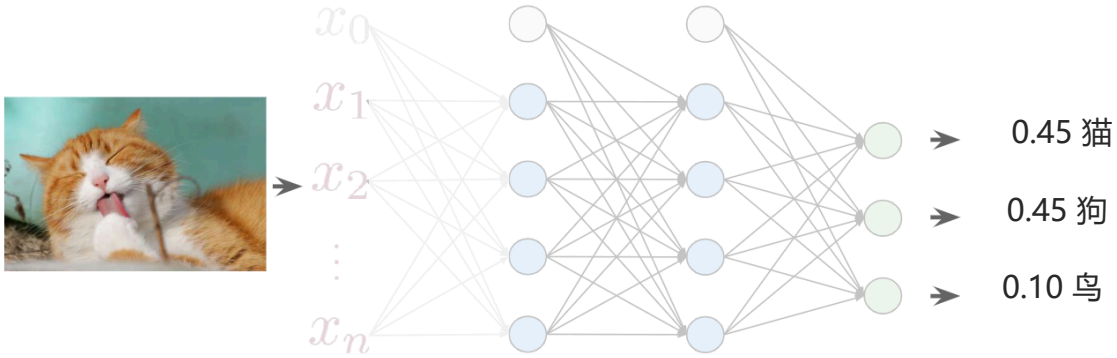
神经网络



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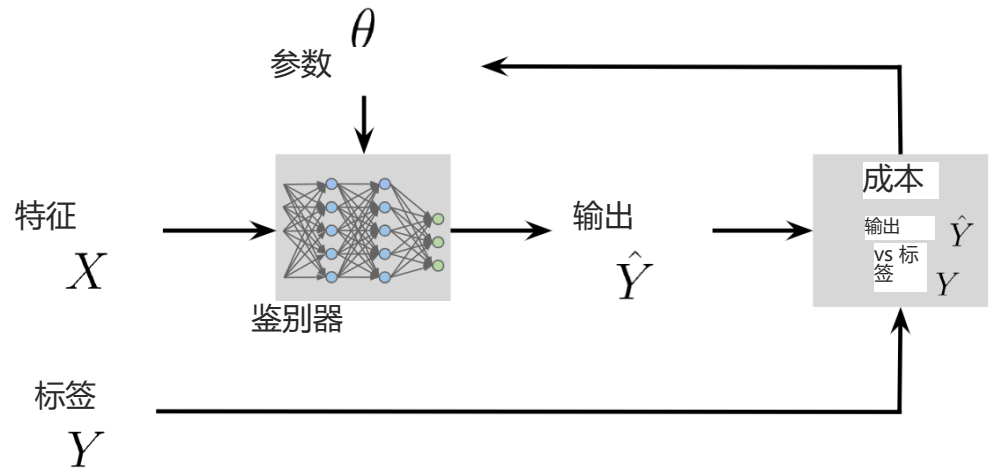
分类器（训练）



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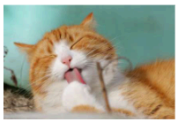
分类

$$P(\text{海龟}, \text{鸟}, \text{猫}, \text{狗}, \text{鱼} \mid \text{  })$$

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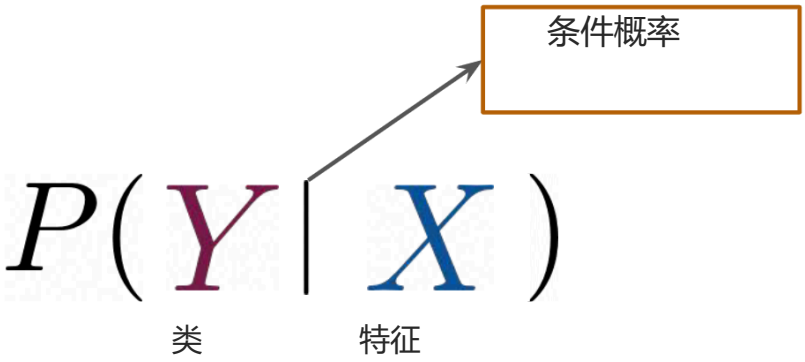
分类



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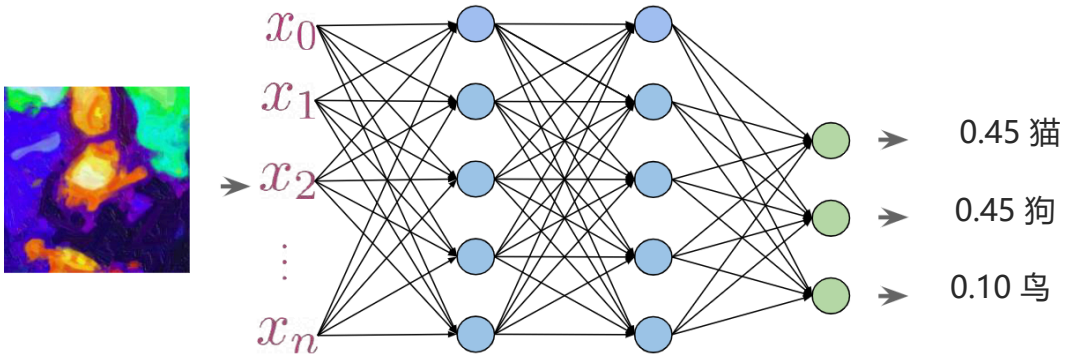
鉴别器



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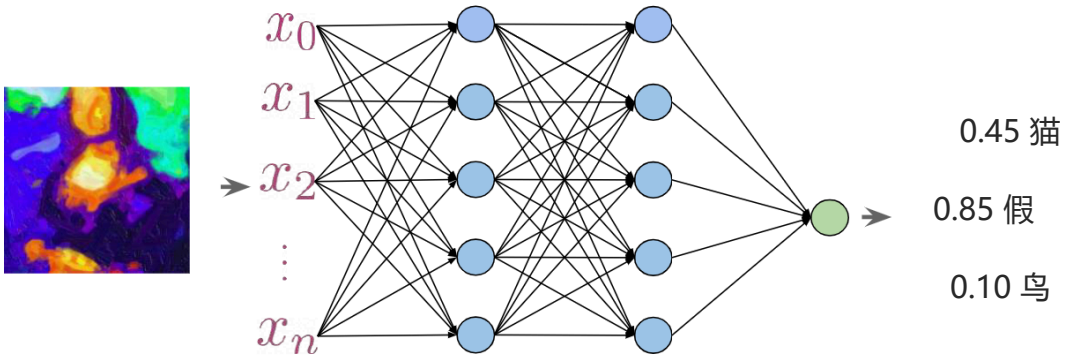
鉴别器



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鉴别器

$$P(\text{假} \mid X)$$

类　　特征

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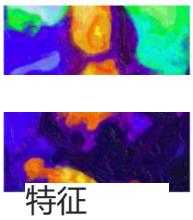
鉴别器

$$P(\text{假} \mid \text{特征}) = 0.85$$

假类



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总结

- 鉴别器是一个分类器
- 它学习给定特征 X 的 Y 类（真实或虚假）的概率
- 概率是生成器的反馈

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发电机

大纲

- 生成器的作用
- 如何提高性能
- 概率方面的生成器

发电机

海龟

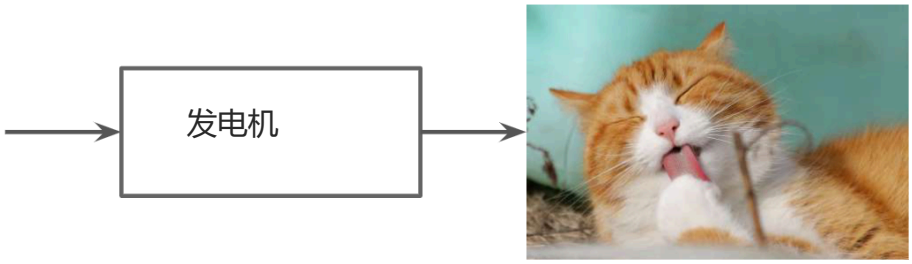
鸟

猫

狗

鱼

生成类的示例



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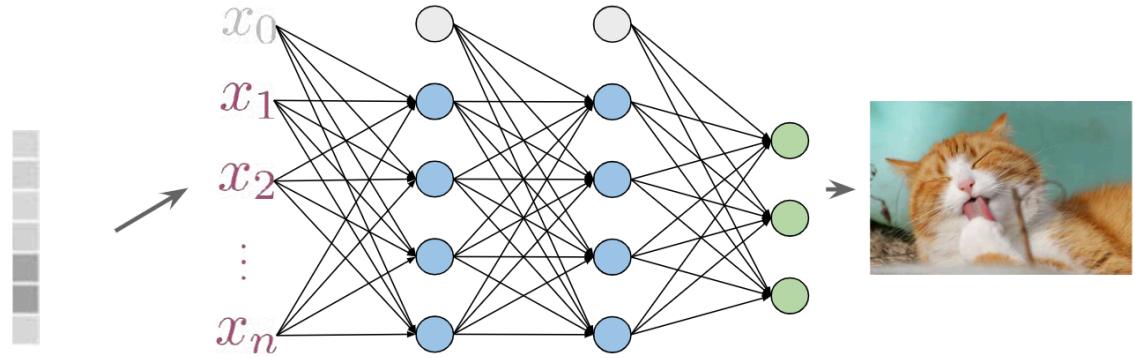
神经网络



噪声（随机特征）

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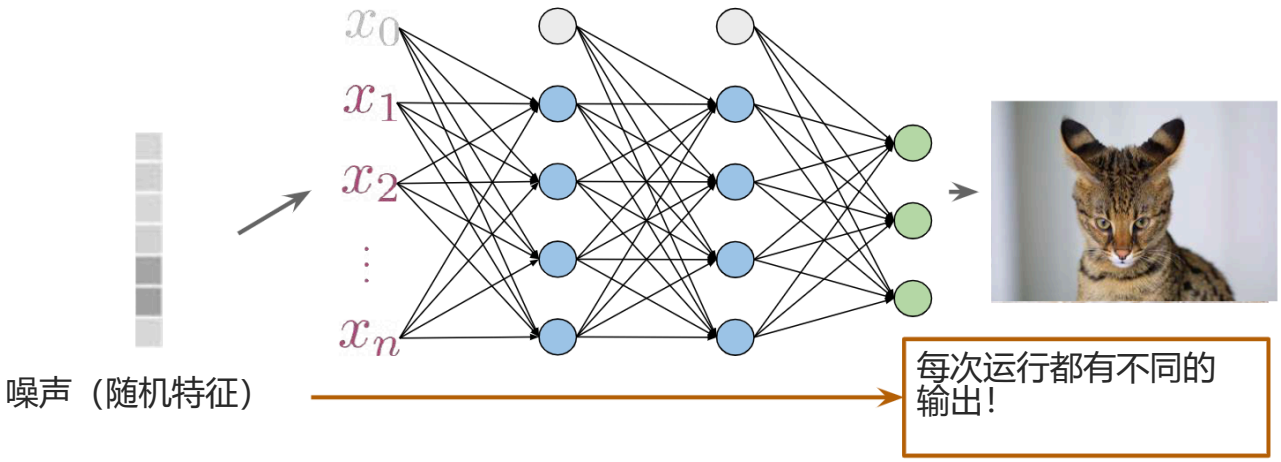
神经网络



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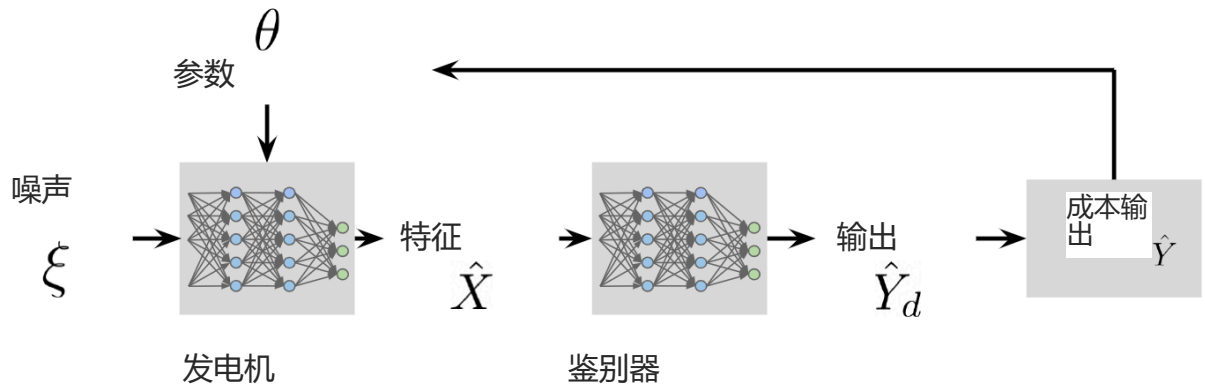
生成器：学习



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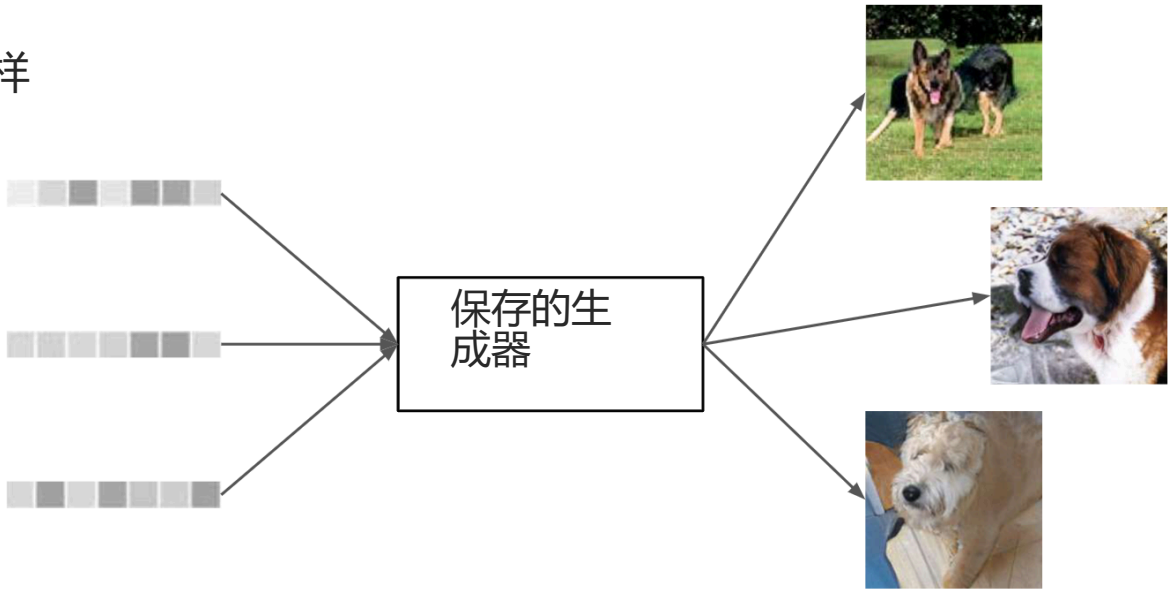
采样



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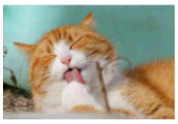
发电机

$$P(\ \text{  }\ \mid \text{海龟 鸟 猫 狗 鱼})$$

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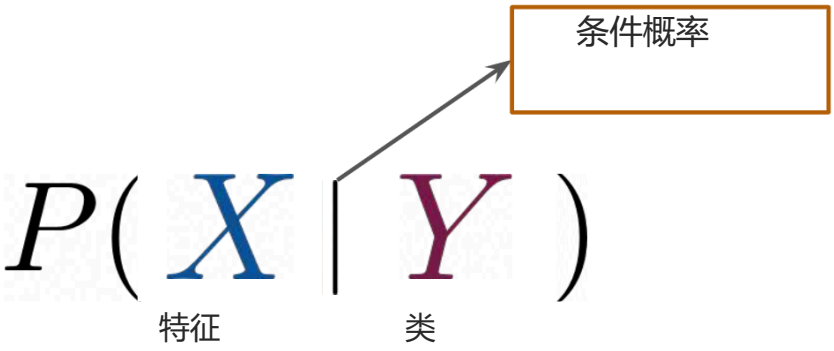
发电机



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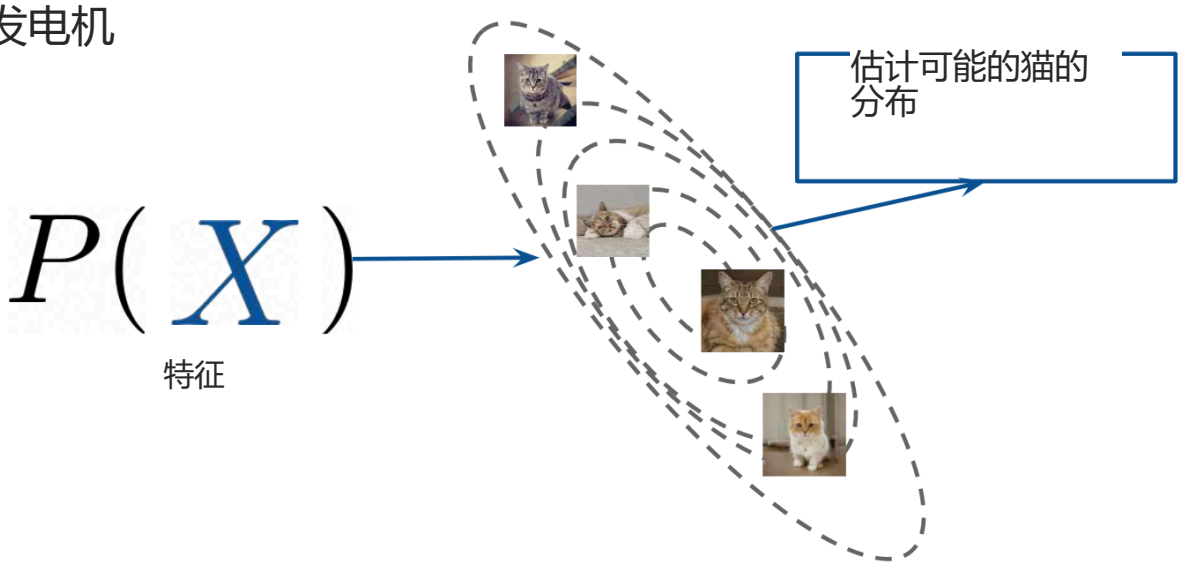
发电机



图片来自：http://thesecatsdonotexist.com/

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总结

- 生成器产生虚假数据
- 它学习特征 X 的概率
- 生成器将输入噪声（随机特征）

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BCE 成本函数

大纲

- 二进制交叉熵 （BCE） 损失方程各部分
- 图形外观

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BCE 成本函数

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

预测 标签 特征 参数

整批平均损失

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BCE 成本函数

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

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BCE 成本函数

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

$y^{(i)}$	$h(x^{(i)},\theta)$	$y^{(i)}\log h(x^{(i)},\theta)$
0	任何	0
1	0.99	~0
1	~0	-inf

当标签为 1 时相关

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BCE 成本函数

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

$y^{(i)}$	$h(x^{(i)},\theta)$	$(1-y^{(i)})\log(1-h(x^{(i)},\theta))$
1	任何	0
0	0.01	~0
0	~1	-inf

当标签为 0 时相关

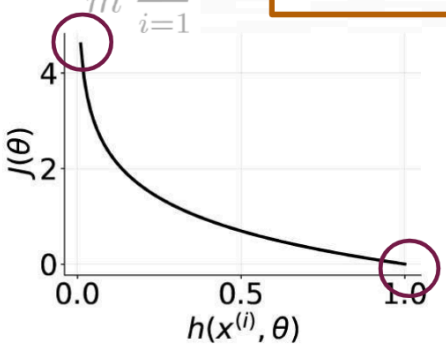
BCE 成本函数

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

确保成本始终大于或等于 0

BCE 成本函数

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



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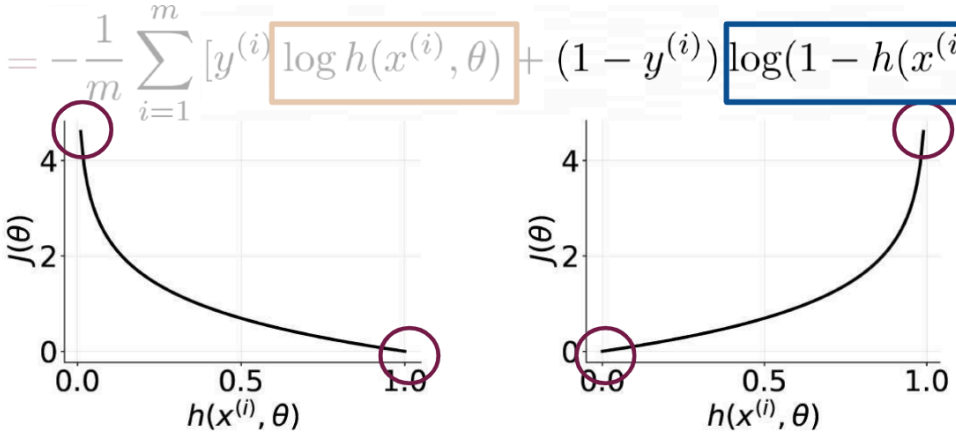
BCE 成本函数

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



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总结

- BCE 成本函数有两个部分（每个类一个相关）
- 当标签和预测相似时，接近零
- 当标签和预测不同时接近无穷大

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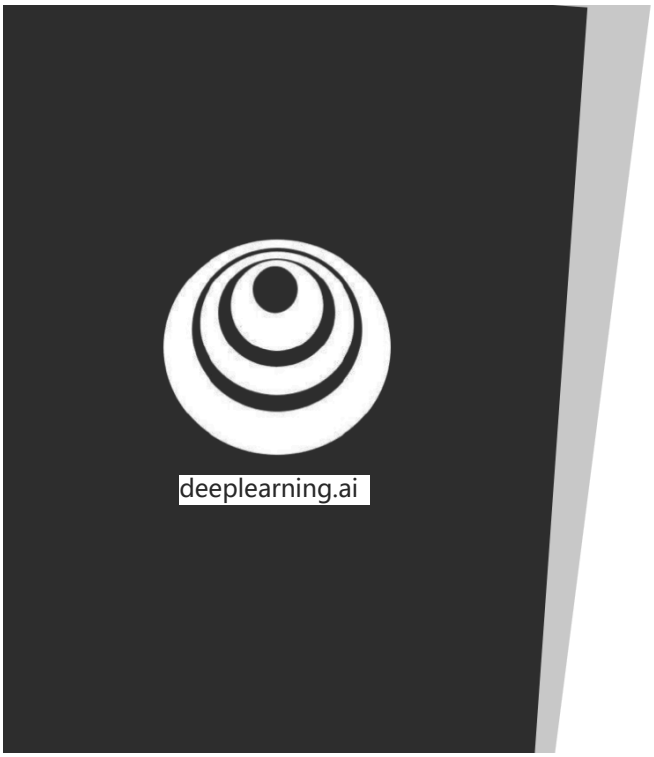
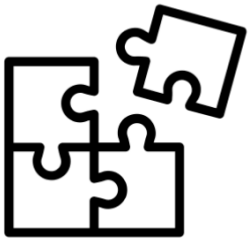


把所有东西都放进去

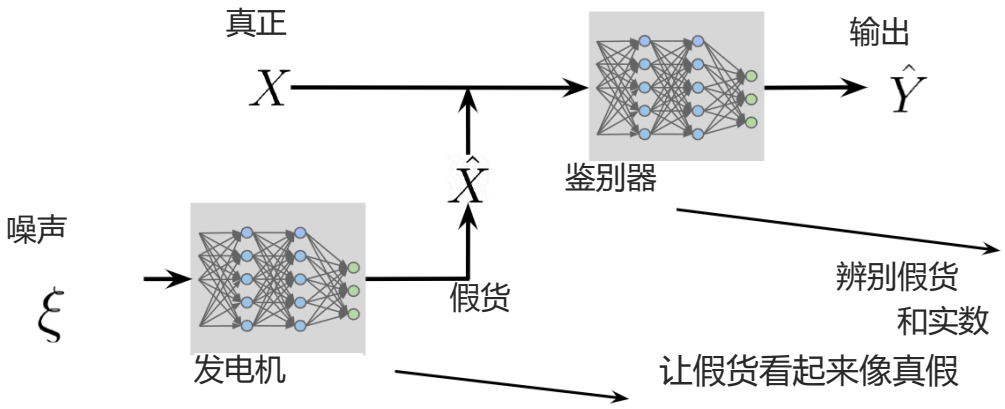
一起

大纲

- 整个架构的外观
- 如何训练 GAN



GAN 模型



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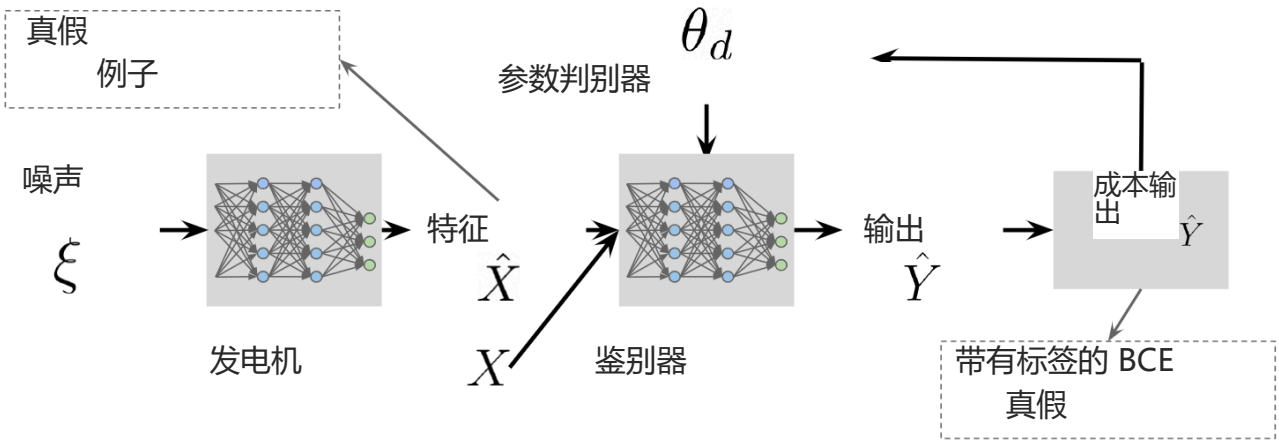
训练 GAN：判别器



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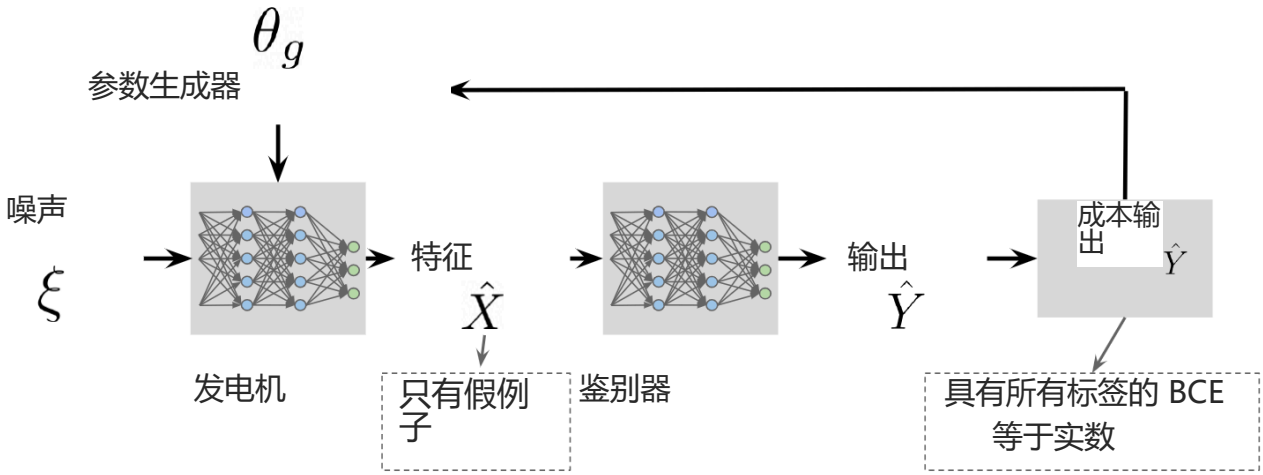
训练 GAN：生成器



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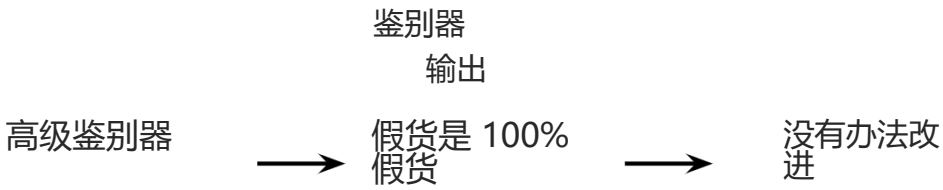
训练 GAN



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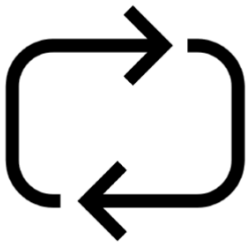
总结

- GAN 以交替的方式训练
- 这两个模型应始终处于相似的“技能”级别



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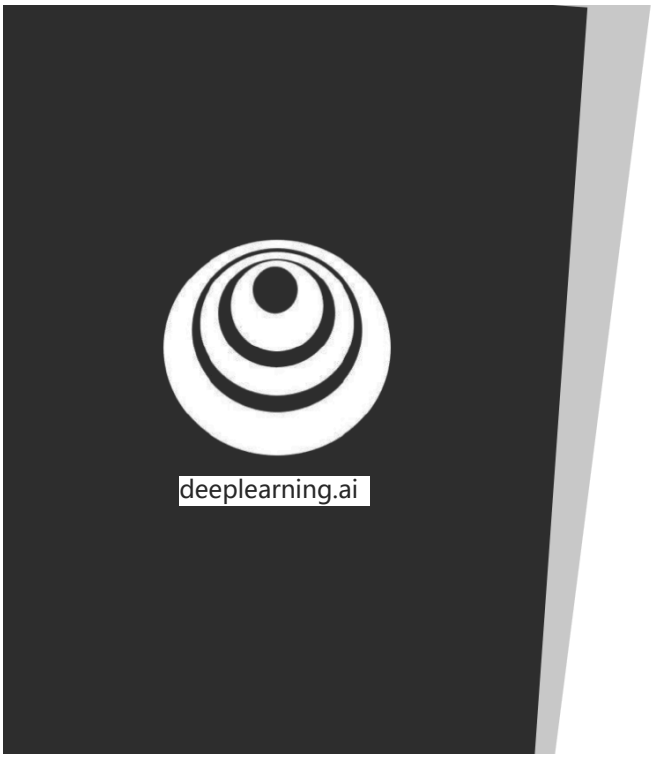
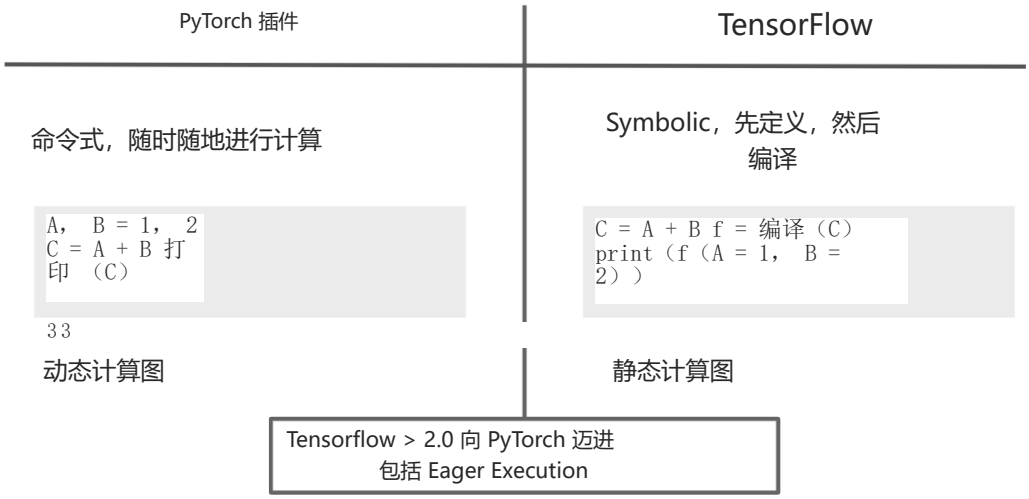


PyTorch 简介（可选）

大纲

- 与 TensorFlow 的比较
- 定义模型
- 训练

PyTorch 与 TensorFlow



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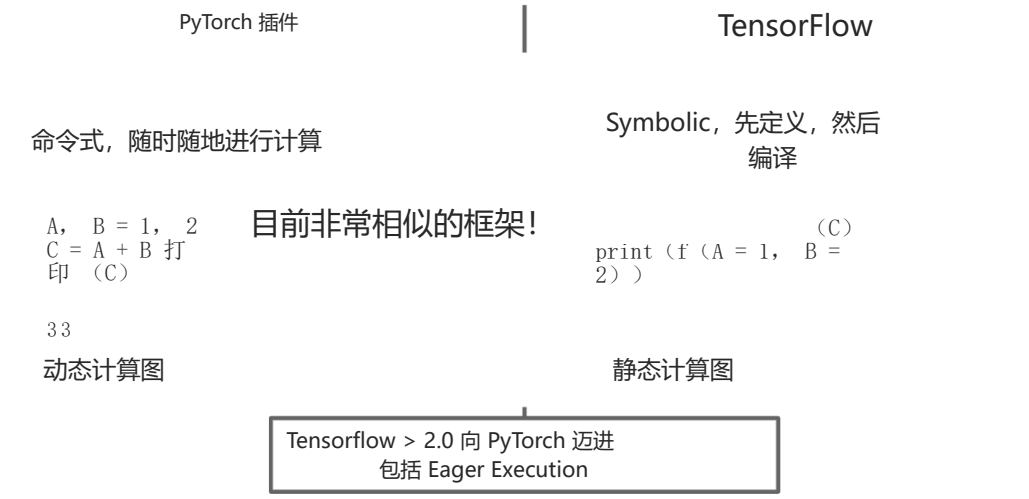
PyTorch 与 TensorFlow



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在 PyTorch 中定义模型

```
从 Torch Import NN 导入
Torch
```

→ DL 的自定义图层

```
class LogisticRegression（nn.模块）：
      def __init__（self， in）：
      super（）.__init__（）
            self.log_reg = nn.顺序 （
                  nn.线性（in，      1），
            nn.Sigmoid（）  ）

      def forward（self， x）：返回
      self.log_reg（x）
```

将模型定义为类

带参数的初始化方法

架构的定义

输入 x 的模型的正向计算

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PyTorch 中的训练模型

```
模型 = LogisticRegression（16）
```

模型的初始化

```
标准 = nn。BCELoss（）
```

成本函数

```
优化器 = torch.optim.SGD（model.parameters（），  lr=0.01）
```

优化

```
对于 range （n_epochs） 中的 t：
      y_pred = 模型 （x） 损失 = 标准
      （y_pred， y）

      optimizer.zero_grad（）
      loss.backward（）
      optimizer.step（）
```

epoch 数的训练循环

前向传播

优化步骤

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总结

- PyTorch 在运行时进行计算
- Pytorch 中的动态计算图
- 只是另一个框架，类似于 Tensorflow!