DDPM 演讲大纲

开场白

Hello, everyone, today our team would like to share the paper —— "Denoising Diffusion Probabilistic Models", which is written by three scholars from UC Berkeley.

大家好，今天我们小组分享的是 DDPM 这篇文章，论文由来自UC Berkeley的三位学者完成。

These are our team members. After this presentation, you will understand why we use these strange avatars.

这是我们的小组成员，在这次展示过后，你将会理解为什么我们使用这组奇怪的头像。

We will divide our presentation into 6 parts.

我们将从六个方面介绍DDPM。

1.背景介绍 Background

At first, what is denoising diffusion probabilistic model. And we can also call it DDPM. The DDPM is a generative model.

DDPM是一个“生成式模型”。

So what is generative model?

也许你们中的一些人并不知道什么是生成模型

什么是生成模型?

For Example, look this picture. It doesn't come from human beings but is generated by NovelAI, which is a popular project on Github.

这张图片并非出自人类之手，而是由NovelAI生成的。目前，这个项目在Github上非常受欢迎。

By just typing the description of the image you want, you can get many fancy pictures from NovelAI.

只需要输入对图片的描述，你就可以获得大量精致的图片。

直观理解 Intuitive understanding

【2张图片】

And all these images are not real, they come from generative models.

这些图片都不是真实存在的，它们都来自于生成式模型。

深度生成模型

The research on generative models has a long time.

针对生成模型的研究已经有了相当的时间。

Here we list some popular generative models in recent years, like GANs，VAEs and flow-based models

2. DDPM模型介绍 Introduction

什么是DDPM

Now it's time to introduce the DDPM.

We can say, in machine learning, diffusion models, also known as diffusion probabilistic models, are a class of latent variable models.

Forget about it, let us see some pictures to understand it intuitively.

忘记这些定义，让我们看一些图片，以便于直观地理解它

微观视角Microscopic

Look this picture. Molecules do random Brownian motion as they diffuse, and their position at each moment follows a small Gaussian distribution;

分子在扩散时做无规则的布朗运动，它们的每一时刻的位置都遵循一个小的高斯分布；

Interestingly, if we put this process backward, the reverse process also follows a small Gaussian distribution.

有意思的是，如果我们把这个过程倒放，这一反向过程同样也遵循高斯分布

And for images, it is the same.

3 扩散模型的原理 Theory

扩散过程

So let's see its theory. The left picture is the initial state and every point represents a real image. In every step, we will add some noise into the image, then these points will diffuse in the whole space, and after thousands of steps, finally the results will close to the standard Gaussian Distribution.

左图是初始状态，每一步，我们在画面中加入一些噪点，然后这些点会在整个空间中扩散，几千步后，最后结果会接近高斯分布

【图片】

前向扩散公式

And this equation shows after we add noise, how those points changed in mathematical form.

这个方程显示了，在我们添加噪声之后，这些点是如何以数学形式变化的。

Here is the Derivation of the formula, if you are interested in it. we can discuss it after the speech.

这是公式的推导，如果你对它感兴趣。我们可以在演讲后讨论。

反向扩散公式

And this is the backward equation, which shows how the standard Gaussian Distribution reverses to images in mathematical form.

这是逆向方程，它显示了高斯分布如何以数学形式反演为真实图片。

Ignore that derivation, we put our attention on the means and the Variance. This is the key to generating a image.

忽略这个推导，我们把注意力放在 except 和 Variance 上。这是生成图片的关键。

Using these formulas, we can build a model p to simulate this process q.

使用这些公式，我们可以构建一个带有代码的模型来模拟此过程。

4 扩散模型的特点 Features

对比图

【表格，看懂表格，组织语言】

Compared to other generative models, each model has its own features, for example, VAEs run fast and is able to generate images at one step.

与其他生成式模型相比，每个模型都有自己的特点，例如，VAEs的速度很快，一次可以生成一张图片。

Although DDPM is slower than other kinds of models, the diffusion has its unique advantage.

尽管速度上DDPM不如其他类型的模型，但是DDPM模型有着自己的独特优势。

It's well-known that GANs can bring high quality pictures, but the diffusion is the better.

DDPM比GANs更好的理由

【对照表格】

The table shows in several datasets, the diffusion models performs better than GANs in quality.

表格显示，多个流行数据集上，Diffusion相比起GANs有着更好的表现。

5. 扩散模型的应用 Application

文本图像 Text2Image

So after all this, what can exactly diffusion model do?

【读ppt】

根据文本生成符合描述的图像，给出一些描述，可生成符合描述的图片。

Here we show an example of a description that a dog is reading, and this is what it generates.

这里我们展示了一个例子，给出描述dog is reading，可以生成一张正在阅读的小狗的图片

图像精细化 Image Refinement

And It can refine the blurry image to be more detailed like this.

对模糊的图像进行精细化，给图片更多的细节。

像素填充 Inpainting

It can also padding the missing image and can complement the details and content of the image.

对缺失内容的图像进行填充，可以补充图像的细节和内容。

填色 Colorization

what's more, it can be used in colorization,

对缺少色彩的图像进行色彩的填充，

we input a grayscale image, and the model can assign appropriate colors.

给出一个例子，我们输入一张灰度图，模型可以对其赋予合适的色彩。

6 担忧与未来 Worries and the future

Now, let's make a conclusion.

The diffusion models might become more and more viable for creative uses in art, photography, and music.

扩散模型也可能在艺术、摄影和音乐中的创造性用途中变得可行

However, there are some negative application for political purpose or other malicious uses. It should be used carefully.

不幸的是，生成模型有许多众所周知的恶意使用。样本生成技术可用于生成高调人物的假图像和视频政治目的

7 引用 References

Here we show our references. And that's all. Thank you.