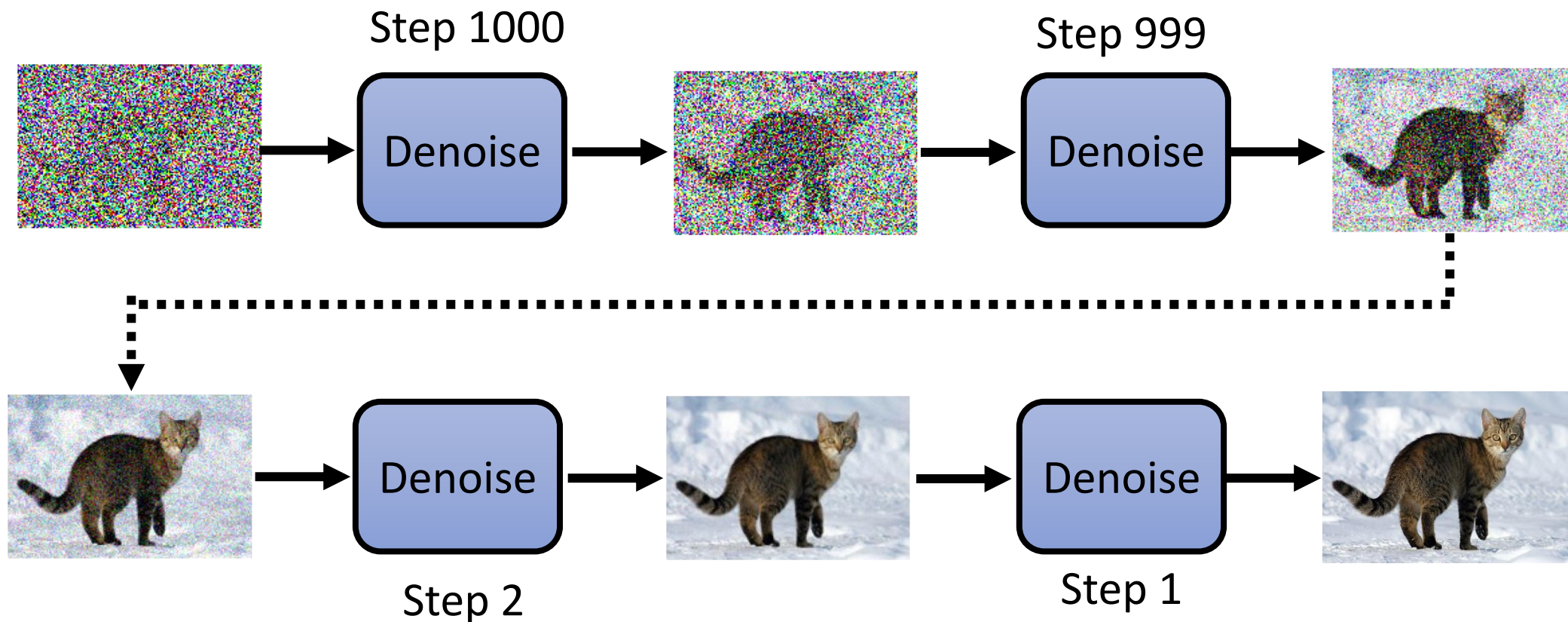


Diffusion Model

Denoising Diffusion Probabilistic Models (DDPM)
<https://arxiv.org/abs/2006.11239>

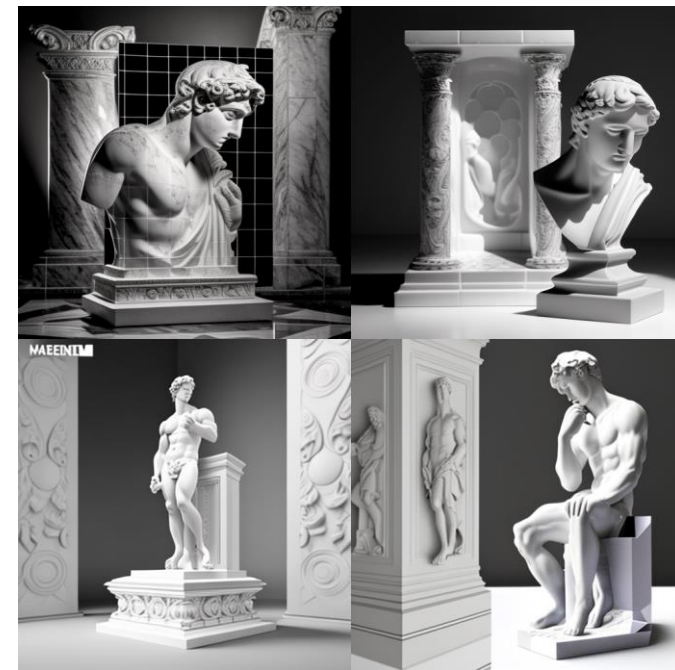
Diffusion Model 是如何運作的？

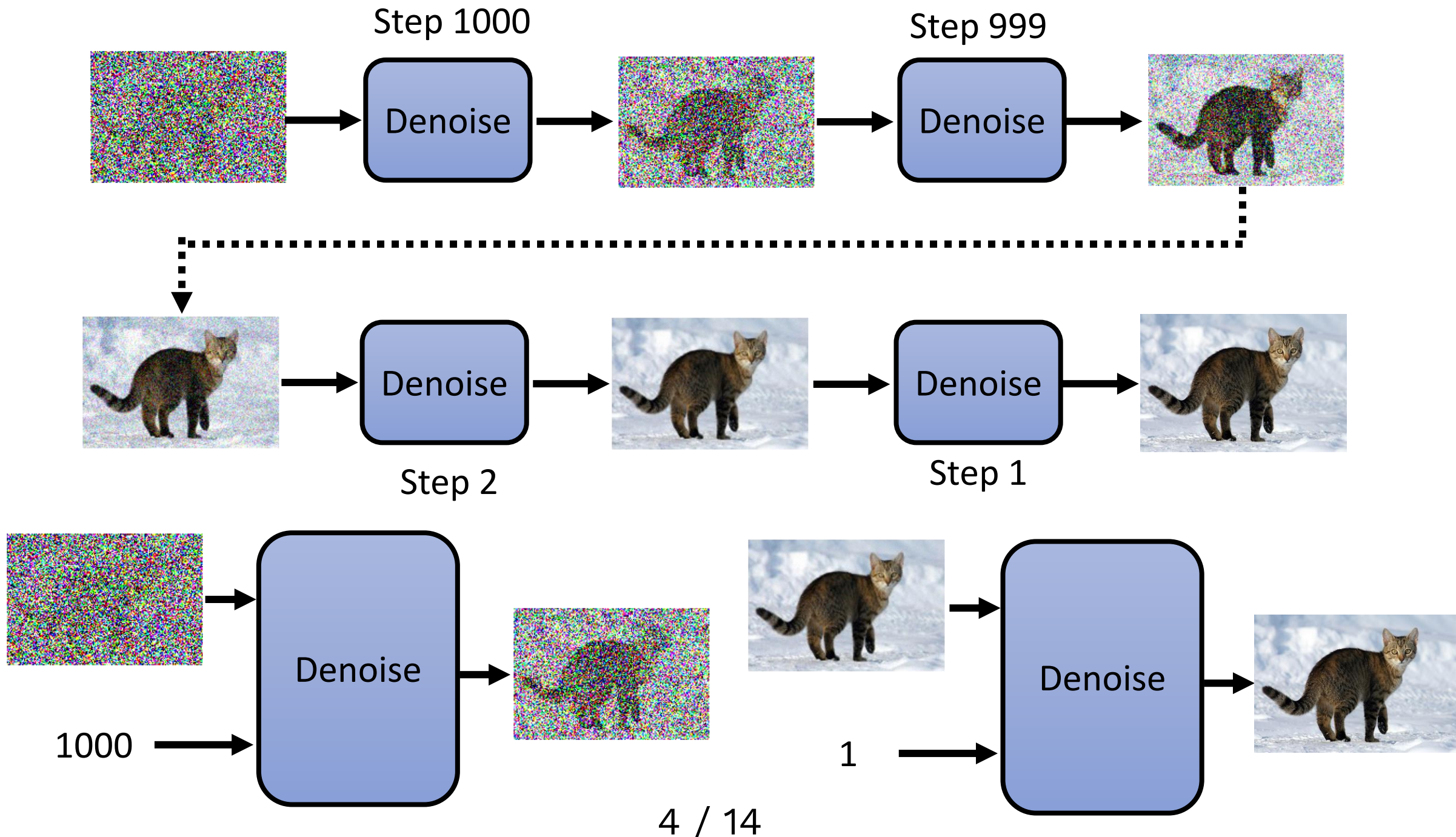


Reverse Process

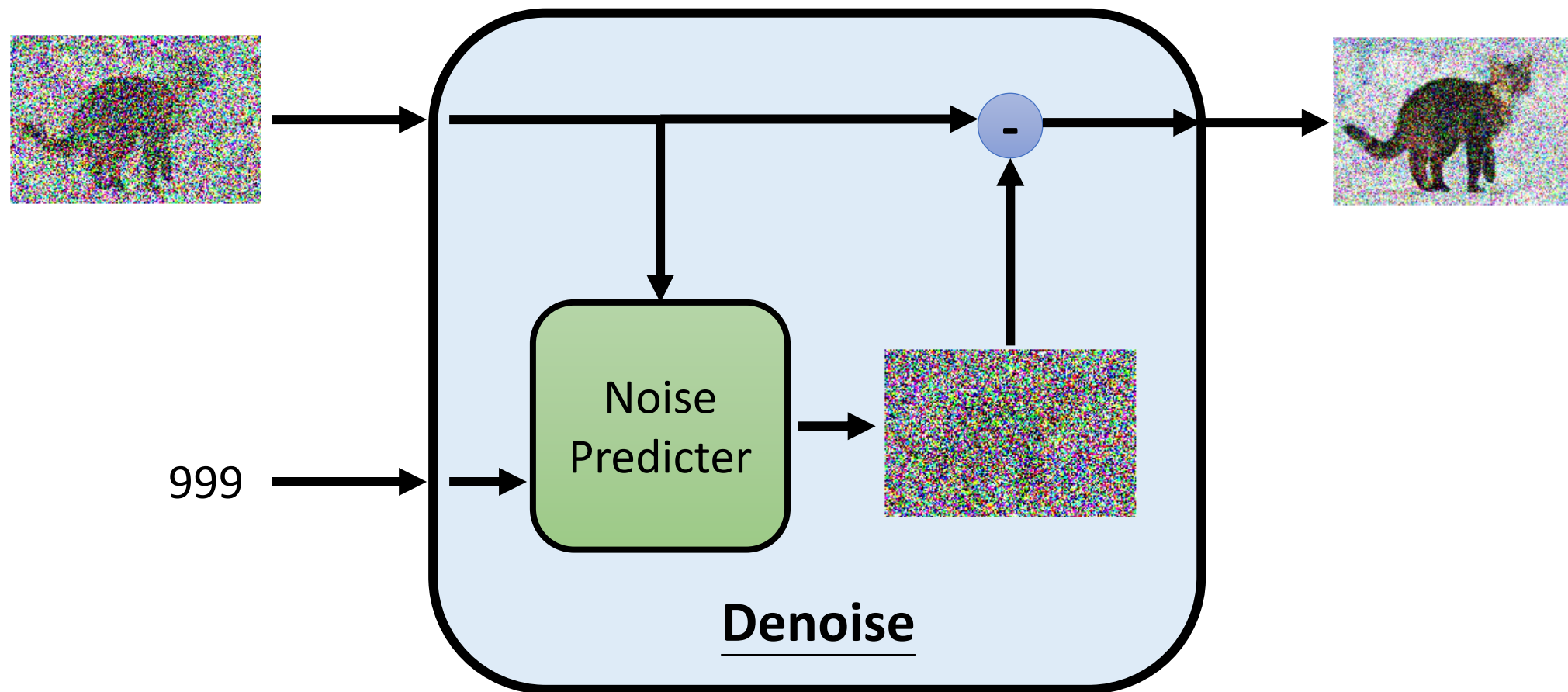


The sculpture is already complete within the marble block, before I start my work. It is already there, I just have to chisel away the superfluous material. - **Michelangelo**

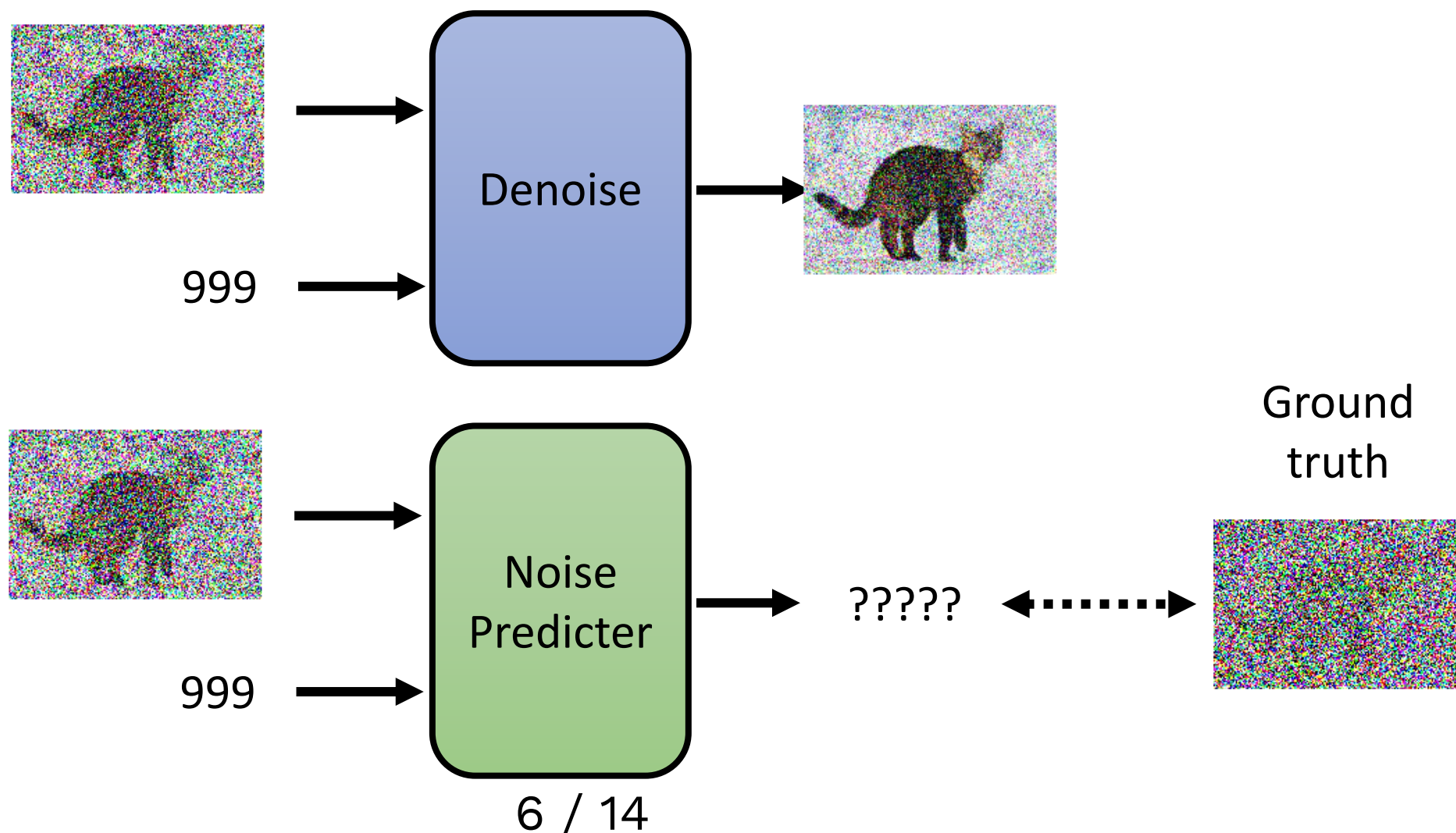


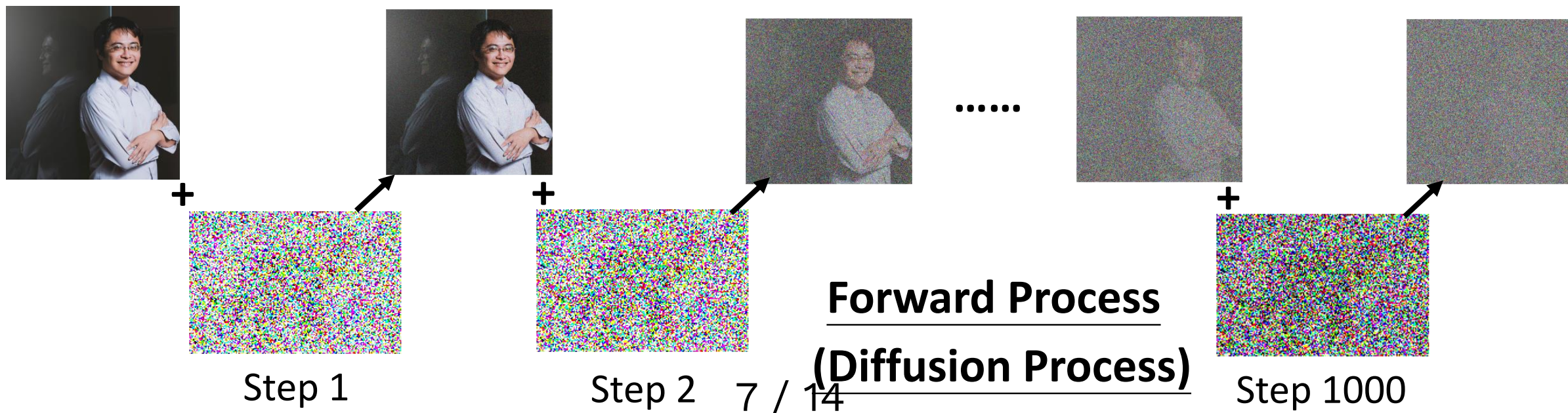
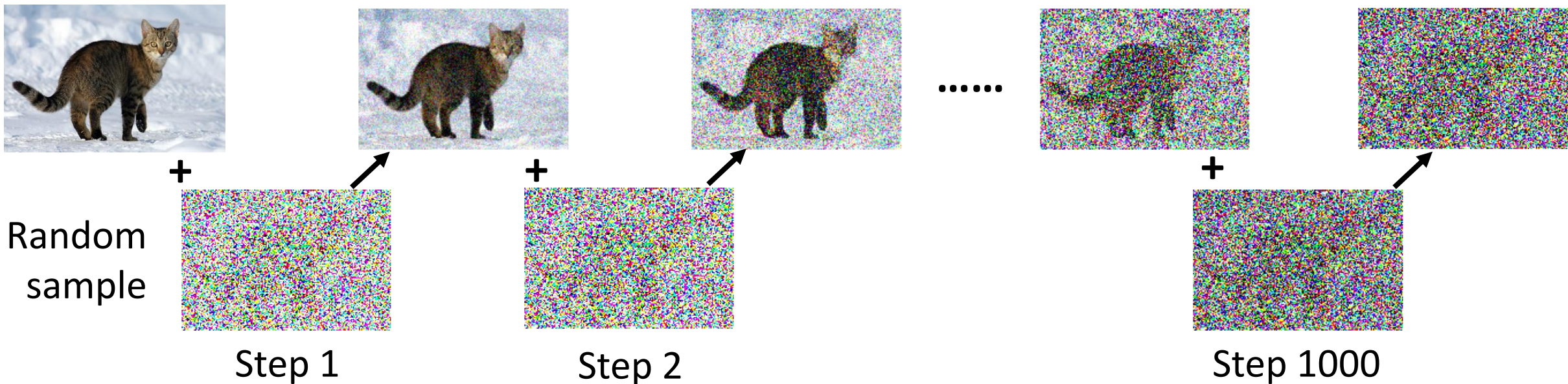


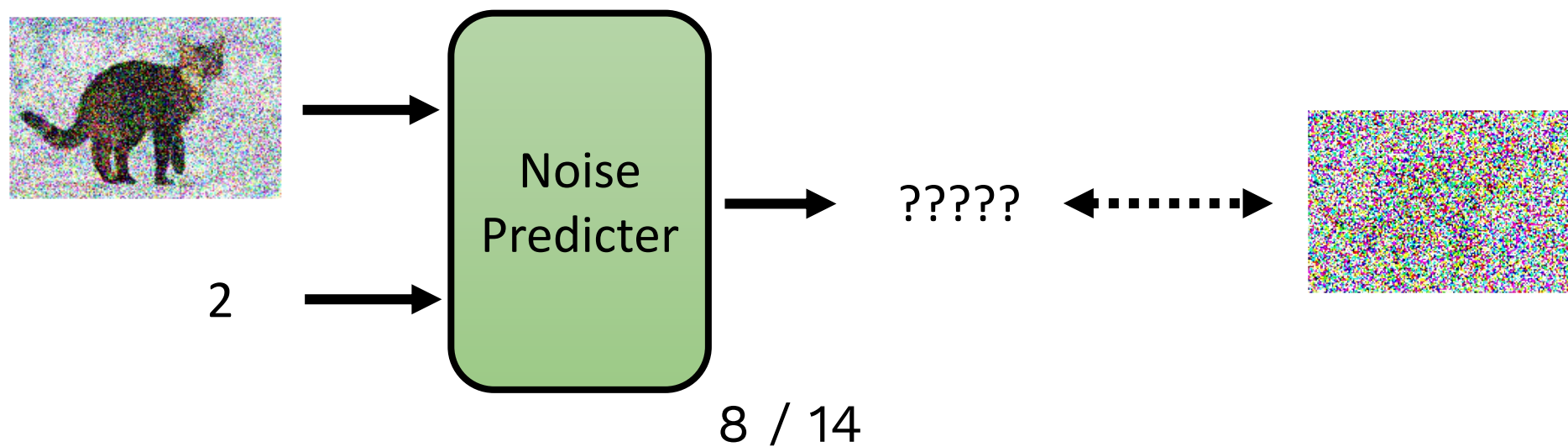
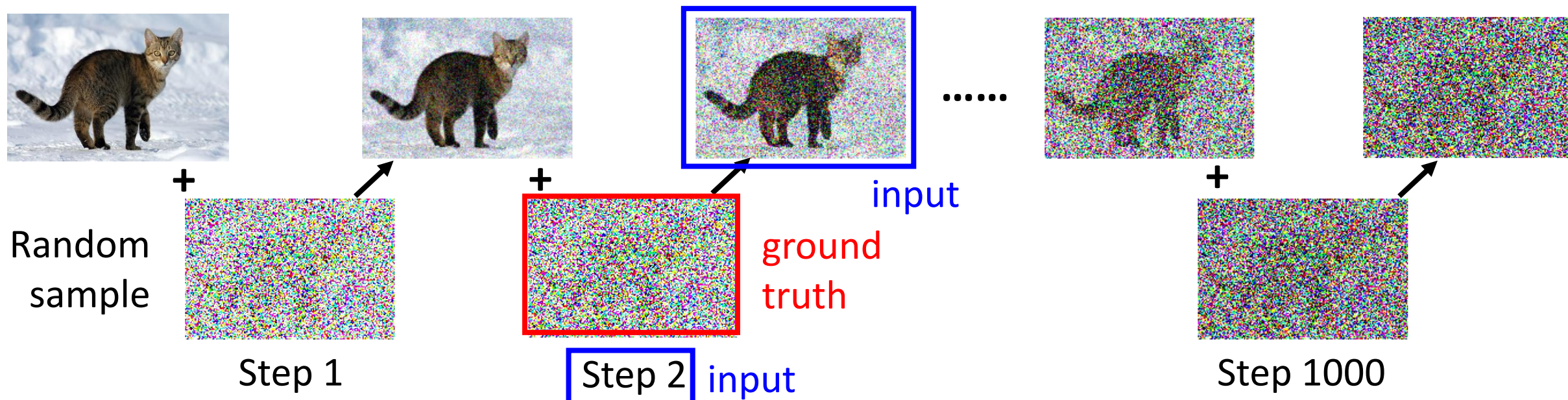
Denoise 模組內部實際做的事情



如何訓練 Noise Predictor







Text-to-Image

<https://laion.ai/blog/laion-5b/>

A cat in
the snow



Text-to-image
Generator



HW6

70k



ImageNet

1M



LAION

5.85B

Backend url:

<https://knn5.laion.ai>

Index:

laion_5B

french cat

[Clip retrieval](#) works by converting the text query to a CLIP embedding, then using that embedding to query a knn index of clip image embeddings

Display captions ☒

Display full captions ☐

Display similarities ☐

Safe mode ☒

Hide duplicate urls ☒

Hide (near) duplicate images ☒

Search over

image

Search with multilingual clip



french cat



french cat



How to tell if your feline is french. He wears a b...



Winter cat



網友挑戰「加幾筆畫出最創意貓咪圖片」，第9位得主的作品



cat in a suit Georgian sells tomatoes

Text-to-Image

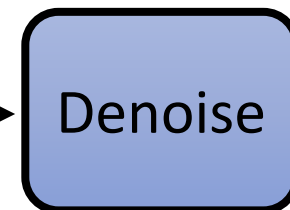
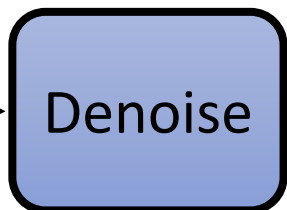
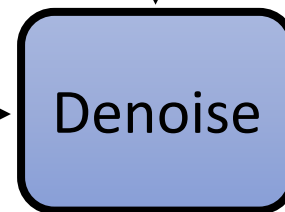
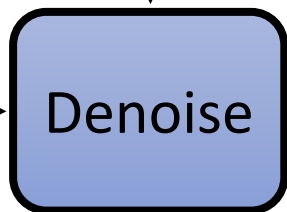
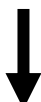
A cat in
the snow



Text-to-image
Generator



A cat in the snow



A cat in the snow



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A cat in the snow



Text-to-Image

A cat in
the snow



Text-to-image
Generator

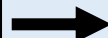


A cat in the snow

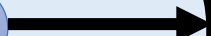
999



Noise
Predictor

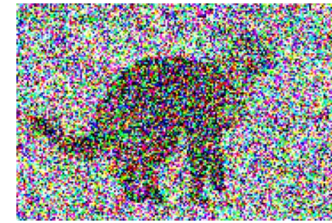


-



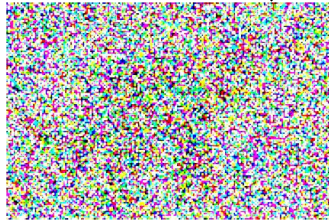
Denoise

A cat in the snow input

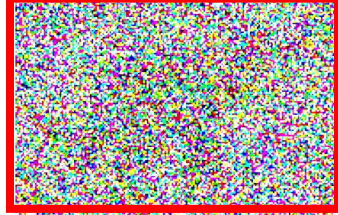


.....

Random
sample



Step 1



ground
truth

Step 2 input

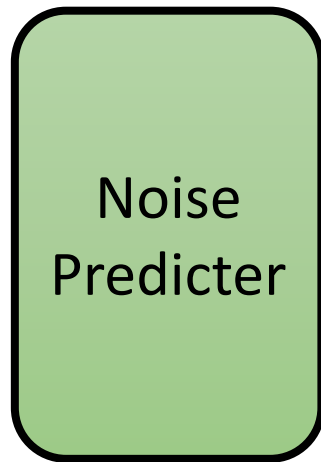


Step 1000



A cat in the snow

2



?????

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Denoising Diffusion Probabilistic Models

Algorithm 1 Training

```
1: repeat  
2:    $\mathbf{x}_0 \sim q(\mathbf{x}_0)$   
3:    $t \sim \text{Uniform}(\{1, \dots, T\})$   
4:    $\epsilon \sim \mathcal{N}(\mathbf{0}, \mathbf{I})$   
5:   Take gradient descent step on  
        $\nabla_{\theta} \|\epsilon - \epsilon_{\theta}(\sqrt{\bar{\alpha}_t}\mathbf{x}_0 + \sqrt{1 - \bar{\alpha}_t}\epsilon, t)\|^2$   
6: until converged
```

Algorithm 2 Sampling

```
1:  $\mathbf{x}_T \sim \mathcal{N}(\mathbf{0}, \mathbf{I})$   
2: for  $t = T, \dots, 1$  do  
3:    $\mathbf{z} \sim \mathcal{N}(\mathbf{0}, \mathbf{I})$  if  $t > 1$ , else  $\mathbf{z} = \mathbf{0}$   
4:    $\mathbf{x}_{t-1} = \frac{1}{\sqrt{\alpha_t}} \left( \mathbf{x}_t - \frac{1 - \alpha_t}{\sqrt{1 - \bar{\alpha}_t}} \epsilon_{\theta}(\mathbf{x}_t, t) \right) + \sigma_t \mathbf{z}$   
5: end for  
6: return  $\mathbf{x}_0$ 
```

Diffusion Model

Denoising Diffusion Probabilistic Models (DDPM)
<https://arxiv.org/abs/2006.11239>