# Program Documentation for Line drawing guided Denoising Diffusion Model

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# Chapter 1

# Hierarchical Index

## 1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

# Chapter 2

# Class Index

## 2.1 Class List

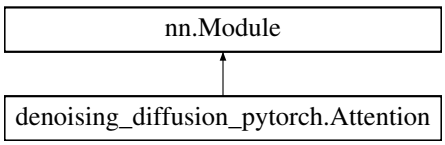
Here are the classes, structs, unions and interfaces with brief descriptions:

# Chapter 3

# Class Documentation

## 3.1 denoising_diffusion_pytorch.Attention Class Reference

Inheritance diagram for denoising_diffusion_pytorch.Attention:




#### Public Member Functions

- **__init__** (self, dim, heads=4, dim_head=32)
- **forward** (self, x)

#### Public Attributes

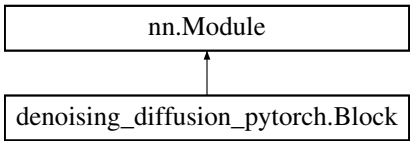
- **scale**
- **heads**
- **to_qkv**
- **to_out**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.2 denoising_diffusion_pytorch.Block Class Reference

Inheritance diagram for denoising_diffusion_pytorch.Block:



**Public Member Functions**

- **__init__** (self, dim, dim_out, groups=8)
- **forward** (self, x, scale_shift=None)

**Public Attributes**

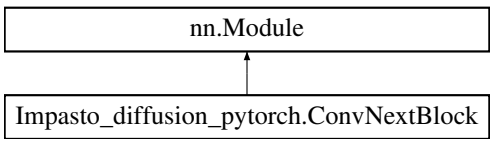
- **proj**
- **norm**
- **act**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.3 Impasto_diffusion_pytorch.ConvNextBlock Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.ConvNextBlock:




**Public Member Functions**

- **__init__** (self, dim, dim_out, *time_emb_dim=None, mult=2, norm=True)
- **forward** (self, x, time_emb=None)

**Public Attributes**

- **mlp**
- **ds_conv**
- **net**
- **res_conv**

### 3.3.1 Detailed Description

```
https://arxiv.org/abs/2201.03545
```

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.4 denoising_diffusion_pytorch.Dataset Class Reference

#### Public Member Functions

- **__init__** (self, folder, image_size, exts=['jpg', 'jpeg', 'png', 'tiff'], augment_horizontal_flip=False, convert_↩ image_to=None)
- **__len__** (self)
- **__getitem__** (self, index)

#### Public Attributes

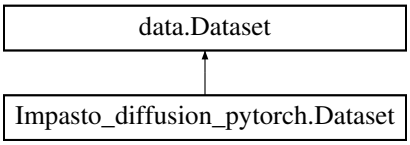
- **folder**
- **image_size**
- **paths**
- **transform**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.5 Impasto_diffusion_pytorch.Dataset Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.Dataset:




#### Public Member Functions

- **__init__** (self, folder, image_size, exts=['jpg', 'jpeg', 'png'])
- **__len__** (self)
- **__getitem__** (self, index)

#### Public Attributes

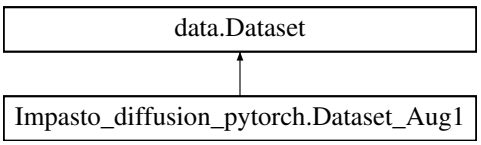
- **folder**
- **image_size**
- **paths**
- **transform**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.6 Impasto_diffusion_pytorch.Dataset_Aug1 Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.Dataset_Aug1:




#### Public Member Functions

- **__init__** (self, folder, image_size, exts=['jpg', 'jpeg', 'png'])
- **__len__** (self)
- **__getitem__** (self, index)

#### Public Attributes

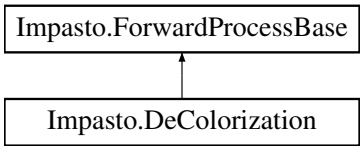
- **folder**
- **image_size**
- **paths**
- **transform**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.7 Impasto.DeColorization Class Reference

Inheritance diagram for Impasto.DeColorization:




#### Public Member Functions

- **__init__** (self, decolor_routine='Constant', decolor_ema_factor=0.9, decolor_total_remove=False, num_↩ timesteps=50, channels=3, to_lab=False)
- **get_conv** (self, decolor_ema_factor)
- **get_kernels** (self)
- forward (self, x, i, og=None)
- **total_forward** (self, x_in)

### Public Member Functions inherited from Impasto.ForwardProcessBase

- **forward** (self, x, i)
- **reset_parameters** (self, batch_size=32)

#### Public Attributes

- **decolor_routine**
- **decolor_ema_factor**
- **decolor_total_remove**
- **channels**
- **num_timesteps**
- **device_of_kernel**
- **kernels**
- **to_lab**

### 3.7.1 Member Function Documentation

#### 3.7.1.1 forward()

```
Impasto.DeColorization.forward (
              self,
              x,
              i,
              og = None )
```

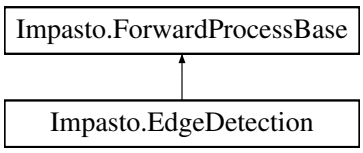
Reimplemented from Impasto.ForwardProcessBase.

The documentation for this class was generated from the following file:

- Impasto.py

## 3.8 Impasto.EdgeDetection Class Reference

Inheritance diagram for Impasto.EdgeDetection:




#### Public Member Functions

- **__init__** (self, min_number_of_color=20, max_number_of_color=256, num_timesteps=50, channels=3, canny_threshold1=100, canny_threshold2=200)
- forward (self, x, step, og_img=None)

### Public Member Functions inherited from Impasto.ForwardProcessBase

- **forward** (self, x, i)
- **reset_parameters** (self, batch_size=32)

#### Public Attributes

- **min_number_of_color**
- **max_number_of_color**
- **num_timesteps**
- **channels**
- **canny_threshold1**
- **canny_threshold2**

### 3.8.1 Member Function Documentation

#### 3.8.1.1 forward()

```
Impasto.EdgeDetection.forward (
              self,
              x,
              step,
              og_img = None )
```

Reimplemented from Impasto.ForwardProcessBase.

The documentation for this class was generated from the following file:

- Impasto.py

## 3.9 Impasto_diffusion_pytorch.EMA Class Reference

#### Public Member Functions

- **__init__** (self, beta)
- **update_model_average** (self, ma_model, current_model)
- **update_average** (self, old, new)

#### Public Attributes

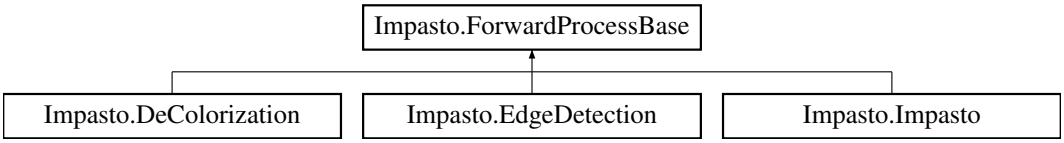
- **beta**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.10 Impasto.ForwardProcessBase Class Reference

Inheritance diagram for Impasto.ForwardProcessBase:




#### Public Member Functions

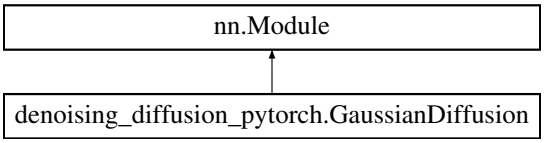
- **forward** (self, x, i)
- **reset_parameters** (self, batch_size=32)

The documentation for this class was generated from the following file:

- Impasto.py

## 3.11 denoising_diffusion_pytorch.GaussianDiffusion Class Reference

Inheritance diagram for denoising_diffusion_pytorch.GaussianDiffusion:




#### Public Member Functions

- **__init__** (self, model, ∗image_size, timesteps=1000, sampling_timesteps=None, objective='pred_v', beta_↩ schedule='cosine', schedule_fn_kwargs=dict(), ddim_sampling_eta=0., auto_normalize=True, offset_noise↩ _strength=0., min_snr_loss_weight=False, min_snr_gamma=5)
- **device** (self)
- **predict_start_from_noise** (self, x_t, t, noise)
- **predict_noise_from_start** (self, x_t, t, x0)
- **predict_v** (self, x_start, t, noise)
- **predict_start_from_v** (self, x_t, t, v)
- **q_posterior** (self, x_start, x_t, t)
- **model_predictions** (self, x, t, x_self_cond=None, clip_x_start=False, rederive_pred_noise=False)
- **p_mean_variance** (self, x, t, x_self_cond=None, clip_denoised=True)
- **p_sample** (self, x, int t, x_self_cond=None)
- **p_sample_loop** (self, shape, return_all_timesteps=False, img=None, og_img=None)
- **ddim_sample** (self, shape, return_all_timesteps=False, img=None, og_img=None)
- **sample** (self, batch_size=16, return_all_timesteps=False, og_img=None)
- **q_sample** (self, x_start, t, noise=None)
- **p_losses** (self, x_start, t, noise=None, offset_noise_strength=None)
- **forward** (self, img, ∗args, ∗∗kwargs)
- **get_edge** (self, og_img)

**Public Attributes**

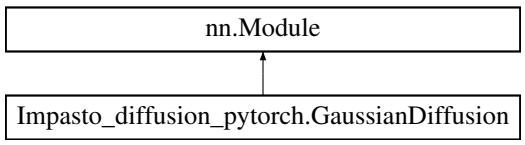
- **model**
- **channels**
- **self_condition**
- **image_size**
- **objective**
- **num_timesteps**
- **sampling_timesteps**
- **is_ddim_sampling**
- **ddim_sampling_eta**
- **offset_noise_strength**
- **normalize**
- **unnormalize**
- **sqrt_recip_alphas_cumprod**
- **sqrt_recipm1_alphas_cumprod**
- **sqrt_alphas_cumprod**
- **sqrt_one_minus_alphas_cumprod**
- **posterior_mean_coef1**
- **posterior_mean_coef2**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.12 Impasto_diffusion_pytorch.GaussianDiffusion Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.GaussianDiffusion:




**Public Member Functions**

- **__init__** (self, denoise_fn, ∗image_size, device_of_kernel, channels=3, timesteps=1000, loss_type='l1', train_routine='Final', sampling_routine='x0_step_down', discrete=False)
- **sample** (self, batch_size=16, img=None, t=None)
- **all_sample** (self, batch_size=16, img=None, t=None, times=None, eval=True)
- **q_sample** (self, x_start, t)
- **p_losses** (self, x_start, t)
- **forward** (self, x, ∗args, ∗∗kwargs)

#### Public Attributes

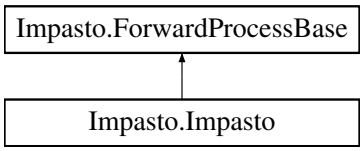
- **channels**
- **image_size**
- **denoise_fn**
- **device_of_kernel**
- **num_timesteps**
- **forward_process**
- **loss_type**
- **train_routine**
- **sampling_routine**
- **discrete**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.13 Impasto.Impasto Class Reference

Inheritance diagram for Impasto.Impasto:




#### Public Member Functions

- **__init__** (self, min_number_of_color=20, max_number_of_color=256, num_timesteps=50, channels=3)
- forward (self, input_tensor, step, og=None)

### Public Member Functions inherited from Impasto.ForwardProcessBase

- **forward** (self, x, i)
- **reset_parameters** (self, batch_size=32)

#### Public Attributes

- **min_number_of_color**
- **max_number_of_color**
- **num_timesteps**
- **channels**
- **device_of_kernel**

### 3.13.1 Member Function Documentation

#### 3.13.1.1 forward()

```
Impasto.Impasto.forward (
              self,
              input_tensor,
              step,
              og = None )
```

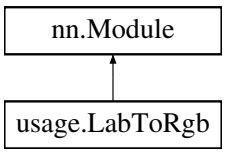
Reimplemented from Impasto.ForwardProcessBase.

The documentation for this class was generated from the following file:

- Impasto.py

## 3.14 usage.LabToRgb Class Reference

Inheritance diagram for usage.LabToRgb:




#### Public Member Functions

- torch.Tensor **forward** (self, torch.Tensor image, bool clip=True)

### 3.14.1 Detailed Description

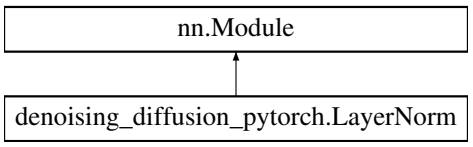
```
Convert an image from Lab to RGB.

Returns:
    RGB version of the image. Range may not be in :math:`[0, 1]`.

Shape:
    - image: :math:`(*, 3, H, W)`
    - output: :math:`(*, 3, H, W)`

Examples:
    >>> input = torch.rand(2, 3, 4, 5)
    >>> rgb = LabToRgb()
    >>> output = rgb(input)  # 2x3x4x5

References:
    [1] https://docs.opencv.org/4.0.1/de/d25/imgproc_color_conversions.html

    [2] https://www.easyrgb.com/en/math.php

    [3] https://github.com/torch/image/blob/dc061b98fb7e946e00034a5fc73e883a299edc7f/generic/image.c#L1518
```

The documentation for this class was generated from the following file:

- usage.py

## 3.15 denoising_diffusion_pytorch.LayerNorm Class Reference

Inheritance diagram for denoising_diffusion_pytorch.LayerNorm:




#### Public Member Functions

- **__init__** (self, dim)
- **forward** (self, x)

#### Public Attributes

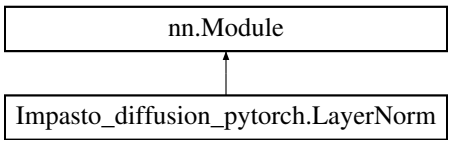
- **g**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.16 Impasto_diffusion_pytorch.LayerNorm Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.LayerNorm:




#### Public Member Functions

- **__init__** (self, dim, eps=1e-5)
- **forward** (self, x)

#### Public Attributes

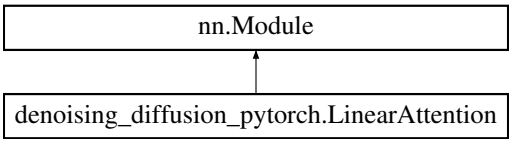
- **eps**
- **g**
- **b**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.17 denoising_diffusion_pytorch.LinearAttention Class Reference

Inheritance diagram for denoising_diffusion_pytorch.LinearAttention:




#### Public Member Functions

- **__init__** (self, dim, heads=4, dim_head=32)
- **forward** (self, x)

#### Public Attributes

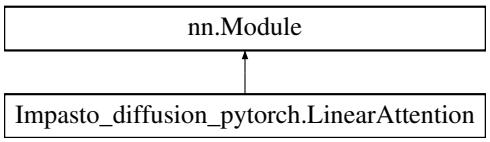
- **scale**
- **heads**
- **to_qkv**
- **to_out**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.18 Impasto_diffusion_pytorch.LinearAttention Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.LinearAttention:




#### Public Member Functions

- **__init__** (self, dim, heads=4, dim_head=32)
- **forward** (self, x)

#### Public Attributes

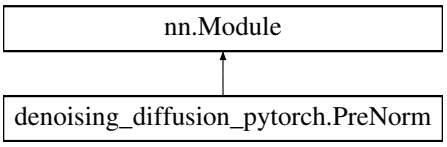
- **scale**
- **heads**
- **to_qkv**
- **to_out**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.19 denoising_diffusion_pytorch.PreNorm Class Reference

Inheritance diagram for denoising_diffusion_pytorch.PreNorm:




#### Public Member Functions

- **__init__** (self, dim, fn)
- **forward** (self, x)

#### Public Attributes

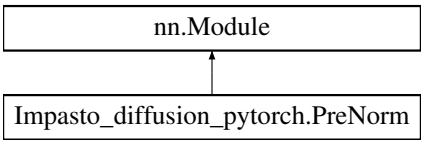
- **fn**
- **norm**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.20 Impasto_diffusion_pytorch.PreNorm Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.PreNorm:




#### Public Member Functions

- **__init__** (self, dim, fn)
- **forward** (self, x)

#### Public Attributes

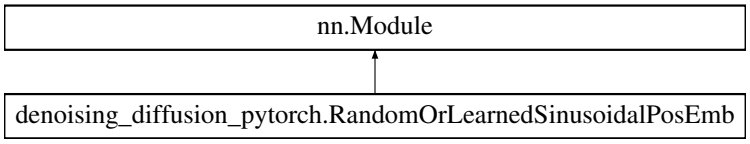
- **fn**
- **norm**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.21 denoising_diffusion_pytorch.RandomOrLearnedSinusoidalPosEmb Class Reference

Inheritance diagram for denoising_diffusion_pytorch.RandomOrLearnedSinusoidalPosEmb:




#### Public Member Functions

- **__init__** (self, dim, is_random=False)
- **forward** (self, x)

#### Public Attributes

- **weights**

### 3.21.1 Detailed Description

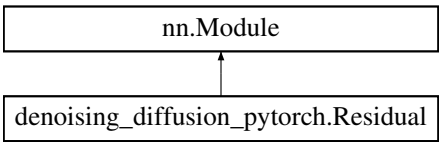
```
following @crowsonkb 's lead with random (learned optional) sinusoidal pos emb

https://github.com/crowsonkb/v-diffusion-jax/blob/master/diffusion/models/danbooru_128.py#L8
```

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.22 denoising_diffusion_pytorch.Residual Class Reference

Inheritance diagram for denoising_diffusion_pytorch.Residual:




#### Public Member Functions

- **__init__** (self, fn)
- **forward** (self, x, ∗args, ∗∗kwargs)

**Public Attributes**

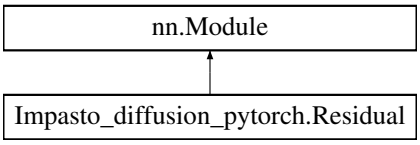
- **fn**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.23 Impasto_diffusion_pytorch.Residual Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.Residual:




**Public Member Functions**

- **__init__** (self, fn)
- **forward** (self, x, ∗args, ∗∗kwargs)

**Public Attributes**

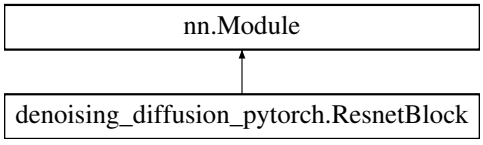
- **fn**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.24 denoising_diffusion_pytorch.ResnetBlock Class Reference

Inheritance diagram for denoising_diffusion_pytorch.ResnetBlock:




**Public Member Functions**

- **__init__** (self, dim, dim_out, ∗time_emb_dim=None, groups=8)
- **forward** (self, x, time_emb=None)

**Public Attributes**

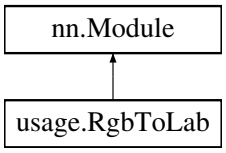
- **mlp**
- **block1**
- **block2**
- **res_conv**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.25 usage.RgbToLab Class Reference

Inheritance diagram for usage.RgbToLab:




**Public Member Functions**

- torch.Tensor **forward** (self, torch.Tensor image)

### 3.25.1 Detailed Description

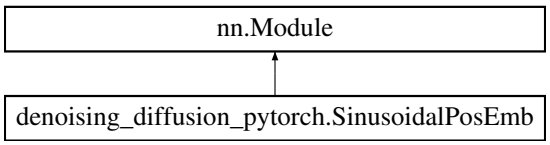
```
Convert an image from RGB to Lab.

The image data is assumed to be in the range of :math:`[0, 1]`. Lab
color is computed using the D65 illuminant and Observer 2.

Returns:
    Lab version of the image.

Shape:
    - image: :math:`(*, 3, H, W)`
    - output: :math:`(*, 3, H, W)`

Examples:
    >>> input = torch.rand(2, 3, 4, 5)
    >>> lab = RgbToLab()
    >>> output = lab(input)  # 2x3x4x5

Reference:
    [1] https://docs.opencv.org/4.0.1/de/d25/imgproc_color_conversions.html

    [2] https://www.easyrgb.com/en/math.php

    [3] https://github.com/torch/image/blob/dc061b98fb7e946e00034a5fc73e883a299edc7f/generic/image.c#L1467
```

The documentation for this class was generated from the following file:

- usage.py

## 3.26 denoising_diffusion_pytorch.SinusoidalPosEmb Class Reference

Inheritance diagram for denoising_diffusion_pytorch.SinusoidalPosEmb:




#### Public Member Functions

- **__init__** (self, dim)
- **forward** (self, x)

#### Public Attributes

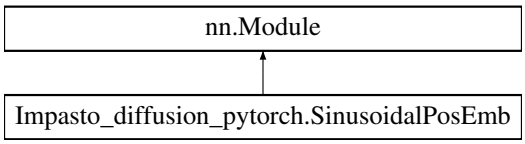
- **dim**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.27 Impasto_diffusion_pytorch.SinusoidalPosEmb Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.SinusoidalPosEmb:




#### Public Member Functions

- **__init__** (self, dim)
- **forward** (self, x)

#### Public Attributes

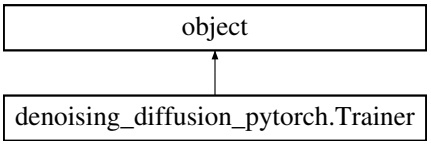
- **dim**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.28 denoising_diffusion_pytorch.Trainer Class Reference

Inheritance diagram for denoising_diffusion_pytorch.Trainer:




#### Public Member Functions

- **__init__** (self, diffusion_model, folder, *train_batch_size=16, gradient_accumulate_every=1, augment_horizontal_flip=True, train_lr=1e-4, train_num_steps=100000, ema_update_every=10, ema_decay=0.995, adam_betas=(0.9, 0.99), save_and_sample_every=1000, num_samples=25, results_folder='./results', amp=False, fp16=False, split_batches=True, convert_image_to=None, calculate_fid=True, inception_block_idx=2048, load_path=None, save_model_every=10000)
- **device** (self)
- **save** (self, milestone)
- **load** (self, milestone)
- **calculate_activation_statistics** (self, samples)
- **fid_score** (self, real_samples, fake_samples)
- **train** (self)
- **test_from_data** (self, extra_path, s_times=None)
- **test_from_painting** (self, train_from_folder=False, input_path=None, img=None, noise=0)

#### Public Attributes

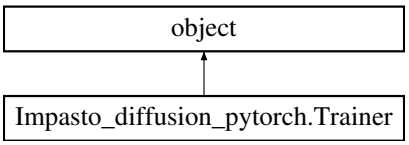
- **accelerator**
- **save_model_every**
- **model**
- **channels**
- **inception_v3**
- **device**
- **num_samples**
- **save_and_sample_every**
- **batch_size**
- **gradient_accumulate_every**
- **train_num_steps**
- **image_size**
- **ds**
- **dl**
- **opt**
- **ema**
- **results_folder**
- **step**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.29 Impasto_diffusion_pytorch.Trainer Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.Trainer:




#### Public Member Functions

- **__init__** (self, diffusion_model, folder, ∗ema_decay=0.995, image_size=128, train_batch_size=32, train_lr=2e-5, train_num_steps=100000, gradient_accumulate_every=2, fp16=False, step_start_↩ ema=2000, update_ema_every=10, save_and_sample_every=100, results_folder='./results', load_↩ path=None, dataset=None, shuffle=True)
- **test_from_line** (self, img_path)
- **test_from_data** (self, extra_path, s_times=None)
- **reset_parameters** (self)
- **step_ema** (self)
- **save** (self, itrs=None)
- **load** (self, load_path)
- **add_title** (self, path, title)
- **train** (self)

#### Public Attributes

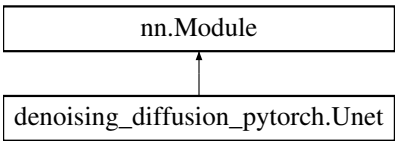
- **model**
- **ema**
- **ema_model**
- **update_ema_every**
- **step_start_ema**
- **save_and_sample_every**
- **batch_size**
- **image_size**
- **gradient_accumulate_every**
- **train_num_steps**
- **ds**
- **dl**
- **opt**
- **step**
- **results_folder**
- **fp16**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.30 denoising_diffusion_pytorch.Unet Class Reference

Inheritance diagram for denoising_diffusion_pytorch.Unet:




#### Public Member Functions

- **__init__** (self, dim, init_dim=None, out_dim=None, dim_mults=(1, 2, 4, 8), channels=3, self_condition=False, resnet_block_groups=8, learned_variance=False, learned_sinusoidal_cond=False, random_fourier_↩ features=False, learned_sinusoidal_dim=16)
- **forward** (self, x, time, x_self_cond=None)

#### Public Attributes

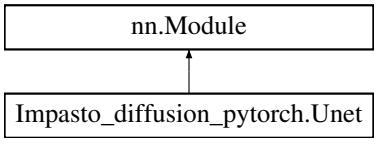
- **channels**
- **self_condition**
- **init_conv**
- **random_or_learned_sinusoidal_cond**
- **time_mlp**
- **downs**
- **ups**
- **mid_block1**
- **mid_attn**
- **mid_block2**
- **out_dim**
- **final_res_block**
- **final_conv**

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

## 3.31 Impasto_diffusion_pytorch.Unet Class Reference

Inheritance diagram for Impasto_diffusion_pytorch.Unet:



**Public Member Functions**

- **__init__** (self, dim, out_dim=None, dim_mults=(1, 2, 4, 8), channels=3, with_time_emb=True, residual=False)
- **forward** (self, x, time)

**Public Attributes**

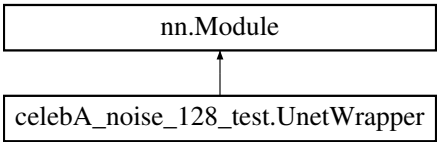
- **channels**
- **residual**
- **time_mlp**
- **downs**
- **ups**
- **mid_block1**
- **mid_attn**
- **mid_block2**
- **final_conv**

The documentation for this class was generated from the following file:

- Impasto_diffusion_pytorch.py

## 3.32 celebA_noise_128_test.UnetWrapper Class Reference

Inheritance diagram for celebA_noise_128_test.UnetWrapper:




**Public Member Functions**

- **__init__** (self, unet)
- **forward** (self, x)

**Public Attributes**

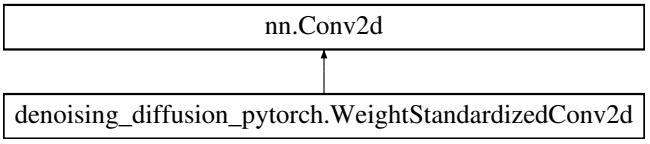
- **unet**

The documentation for this class was generated from the following file:

- celebA_noise_128_test.py

## 3.33 denoising_diffusion_pytorch.WeightStandardizedConv2d Class Reference

Inheritance diagram for denoising_diffusion_pytorch.WeightStandardizedConv2d:




#### Public Member Functions

- **forward** (self, x)

#### Public Attributes

- **bias**
- **stride**
- **padding**
- **dilation**
- **groups**

### 3.33.1 Detailed Description

```
https://arxiv.org/abs/1903.10520
weight standardization purportedly works synergistically with group normalization
```

The documentation for this class was generated from the following file:

- denoising_diffusion_pytorch.py

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