1. Set Up

1.1 Check GPU Status

```
#@title 1.1 Check GPU Status
import subprocess
simple_nvidia_smi_display = False#@param {type:"boolean"}
if simple_nvidia_smi_display:
    #!nvidia-smi
    nvidiasmi_output = subprocess.run(['nvidia-smi', '-L'], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(nvidiasmi_output)
else:
    #!nvidia-smi -i 0 -e 0
    nvidiasmi_output = subprocess.run(['nvidia-smi'], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(nvidiasmi_output)
    nvidiasmi_ecc_note = subprocess.run(['nvidia-smi', '-i', '0', '-e', '0'], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(nvidiasmi_ecc_note)
```

simple_nvidia_smi_display: ☐

```
Tue Jan 24 11:26:53 2023
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.32.03    Driver Version: 460.32.03    CUDA Version: 11.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            Off  | 00000000:00:04.0 Off |                    0* |
| N/A   43C    P0    26W /  70W |      0MiB / 15109MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+

ECC support is already Disabled for GPU 00000000:00:04.0.
All done.
```

1.2 Prepare Folders

```
#@title 1.2 Prepare Folders
import subprocess, os, sys, ipykernel

def gitclone(url, target_dir=None, branch_arg=None):
    run_args = ['git', 'clone']
    if branch_arg:
        run_args.extend(['-b', branch_arg])
    run_args.append(url)
    if target_dir:
        run_args.append(target_dir)
    res = subprocess.run(run_args, stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(res)

def pipi(modulestr):
    res = subprocess.run(['pip', 'install', modulestr], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(res)

def pipie(modulestr):
    res = subprocess.run(['git', 'install', '-e', modulestr], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(res)

def wget(url, outputdir):
    res = subprocess.run(['wget', url, '-P', f'{outputdir}'], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(res)

try:
    from google.colab import drive
    print("Google Colab detected. Using Google Drive.")
```

If you connect your Google Drive, you can save the final image of each run on your drive.

google_drive: ☑

Click here if you'd like to save the diffusion model checkpoint file to (and/or load from) your Google Drive:

save_models_to_google_drive: ☑

```
    is_colab = True
    #@markdown If you connect your Google Drive, you can save the final image of each run on your drive.
    google_drive = True #@param {type:"boolean"}
    #@markdown Click here if you'd like to save the diffusion model checkpoint file to (and/or load from) your Google Drive:
    save_models_to_google_drive = True #@param {type:"boolean"}
    print("Downgrading ipywidgets to latest 7.x in order to enable custom widget manager (for tqdm progress bars)")
    multipip_res = subprocess.run(['pip', 'install', 'ipywidgets>=7,<8'], stdout=subprocess.PIPE).stdout.decode('utf-8')
    print(multipip_res)
    from google.colab import output
    output.enable_custom_widget_manager()
except:
    is_colab = False
    google_drive = False
    save_models_to_google_drive = False
    print("Google Colab not detected.")

if is_colab:
    if google_drive is True:
        drive.mount('/content/drive')
        root_path = '/content/drive/MyDrive/AI/Disco_Diffusion'
    else:
        root_path = '/content'
else:
    root_path = os.getcwd()

import os
def createPath(filepath):
    os.makedirs(filepath, exist_ok=True)

initDirPath = f'{root_path}/init_images'
createPath(initDirPath)
outDirPath = f'{root_path}/images_out'
createPath(outDirPath)

if is_colab:
    if google_drive and not save_models_to_google_drive or not google_drive:
        model_path = '/content/models'
        createPath(model_path)
    if google_drive and save_models_to_google_drive:
        model_path = f'{root_path}/models'
        createPath(model_path)
else:
    model_path = f'{root_path}/models'
    createPath(model_path)

# libraries = f'{root_path}/libraries'
# createPath(libraries)
```

1.3 Install, import dependencies and set up runtime devices

```
#@title ### 1.3 Install, import dependencies and set up runtime devices

import pathlib, shutil, os, sys

# There are some reports that with a T4 or V100 on Colab, downgrading to a previous version of PyTo
# .. but there are also reports that downgrading breaks them!  If you're facing issues, you may wan
# nvidiasmi_output = subprocess.run(['nvidia-smi'], stdout=subprocess.PIPE).stdout.decode('utf-8')
# cards_requiring_downgrade = ["Tesla T4", "V100"]
# if is_colab:
#     if any(cardstr in nvidiasmi_output for cardstr in cards_requiring_downgrade):
#         print("Downgrading pytorch. This can take a couple minutes ...")
#         downgrade_pytorch_result = subprocess.run(['pip', 'install', 'torch==1.10.2', 'torchvisio
#         print("pytorch downgraded.")

#@markdown Check this if you want to use CPU
useCPU = False #@param {type:"boolean"}

if not is_colab:
    # If running locally, there's a good chance your env will need this in order to not crash upon
    os.environ['KMP_DUPLICATE_LIB_OK']='TRUE'

PROJECT_DIR = os.path.abspath(os.getcwd())
USE_ADABINS = True

if is_colab:
    if not google_drive:
        root_path = f'/content'
```

Check this if you want to use CPU

useCPU: ☐

```
        model_path = '/content/models'
else:
    root_path = os.getcwd()
    model_path = f'{root_path}/models'

multipip_res = subprocess.run(['pip', 'install', 'lpips', 'datetime', 'timm', 'ftfy', 'einops', 'py
print(multipip_res)

if is_colab:
    subprocess.run(['apt', 'install', 'imagemagick'], stdout=subprocess.PIPE).stdout.decode('utf-8'

try:
    from CLIP import clip
except:
    if not os.path.exists("CLIP"):
        gitclone("https://github.com/openai/CLIP")
    sys.path.append(f'{PROJECT_DIR}/CLIP')

try:
    import open_clip
except:
    if not os.path.exists("open_clip/src"):
        gitclone("https://github.com/mlfoundations/open_clip.git")
    sys.path.append(f'{PROJECT_DIR}/open_clip/src')
    import open_clip

try:
    from guided_diffusion.script_util import create_model_and_diffusion
except:
    if not os.path.exists("guided-diffusion"):
        gitclone("https://github.com/kostarion/guided-diffusion")
    sys.path.append(f'{PROJECT_DIR}/guided-diffusion')

try:
    from resize_right import resize
except:
    if not os.path.exists("ResizeRight"):
        gitclone("https://github.com/assafshocher/ResizeRight.git")
    sys.path.append(f'{PROJECT_DIR}/ResizeRight')

try:
    import py3d_tools
except:
    if not os.path.exists('pytorch3d-lite'):
        gitclone("https://github.com/MSFTserver/pytorch3d-lite.git")
    sys.path.append(f'{PROJECT_DIR}/pytorch3d-lite')

try:
    from midas.dpt_depth import DPTDepthModel
except:
    if not os.path.exists('MiDaS'):
        gitclone("https://github.com/isl-org/MiDaS.git", branch_arg="v3")
    if not os.path.exists('MiDaS/midas_utils.py'):
        shutil.move('MiDaS/utils.py', 'MiDaS/midas_utils.py')
    if not os.path.exists(f'{model_path}/dpt_large-midas-2f21e586.pt'):
        wget("https://github.com/intel-isl/DPT/releases/download/1_0/dpt_large-midas-2f21e586.pt",
    sys.path.append(f'{PROJECT_DIR}/MiDaS')

try:
    sys.path.append(PROJECT_DIR)
    import disco_xform_utils as dxf
except:
    if not os.path.exists("disco-diffusion"):
        gitclone("https://github.com/alembics/disco-diffusion.git")
    if not os.path.exists('disco_xform_utils.py'):
        shutil.move('disco-diffusion/disco_xform_utils.py', 'disco_xform_utils.py')
    sys.path.append(PROJECT_DIR)

import torch
from dataclasses import dataclass
from functools import partial
import cv2
import pandas as pd
import gc
import io
import math
import timm
from IPython import display
```

```
from IPython import display
import lpips
from PIL import Image, ImageOps
import requests
from glob import glob
import json
from types import SimpleNamespace
from torch import nn
from torch.nn import functional as F
import torchvision.transforms as T
import torchvision.transforms.functional as TF
from tqdm.notebook import tqdm
from CLIP import clip
from resize_right import resize
from guided_diffusion.script_util import create_model_and_diffusion, model_and_diffusion_defaults
from datetime import datetime
import numpy as np
import matplotlib.pyplot as plt
import random
from ipywidgets import Output
import hashlib
from functools import partial
if is_colab:
    os.chdir('/content')
    from google.colab import files
else:
    os.chdir(f'{PROJECT_DIR}')
from IPython.display import Image as ipyimg
from numpy import asarray
from einops import rearrange, repeat
import torch, torchvision
import time
from omegaconf import OmegaConf
import warnings
warnings.filterwarnings("ignore", category=UserWarning)

# AdaBins stuff
if USE_ADABINS:
    try:
        from infer import InferenceHelper
    except:
        if not os.path.exists("AdaBins"):
            gitclone("https://github.com/shariqfarooq123/AdaBins.git")
        if not os.path.exists(f'{PROJECT_DIR}/pretrained/AdaBins_nyu.pt'):
            createPath(f'{PROJECT_DIR}/pretrained')
            wget("https://cloudflare-ipfs.com/ipfs/Qmd2mMnDLWePKmgfS8m6ntAg4nhV5VkUyAydYBp8cWWeB7/A
        sys.path.append(f'{PROJECT_DIR}/AdaBins')
    from infer import InferenceHelper
    MAX_ADABINS_AREA = 500000

import torch
DEVICE = torch.device('cuda:0' if (torch.cuda.is_available() and not useCPU) else 'cpu')
print('Using device:', DEVICE)
device = DEVICE # At least one of the modules expects this name..

if not useCPU:
    if torch.cuda.get_device_capability(DEVICE) == (8,0): ## A100 fix thanks to Emad
        print('Disabling CUDNN for A100 gpu', file=sys.stderr)
        torch.backends.cudnn.enabled = False
```

1.4 Define Midas functions

```
#@title ### 1.4 Define Midas functions

from midas.dpt_depth import DPTDepthModel
from midas.midas_net import MidasNet
from midas.midas_net_custom import MidasNet_small
from midas.transforms import Resize, NormalizeImage, PrepareForNet

# Initialize MiDaS depth model.
# It remains resident in VRAM and likely takes around 2GB VRAM.
# You could instead initialize it for each frame (and free it after each frame) to save VRAM.. but initializing it is slow.
default_models = {
    "midas_v21_small": f"{model_path}/midas_v21_small-70d6b9c8.pt",
    "midas_v21": f"{model_path}/midas_v21-f6b98070.pt",
    "dpt_large": f"{model_path}/dpt_large-midas-2f21e586.pt",
```

```
    "dpt_hybrid": f"{model_path}/dpt_hybrid-midas-501f0c75.pt",
    "dpt_hybrid_nyu": f"{model_path}/dpt_hybrid_nyu-2ce69ec7.pt",}


def init_midas_depth_model(midas_model_type="dpt_large", optimize=True):
    midas_model = None
    net_w = None
    net_h = None
    resize_mode = None
    normalization = None

    print(f"Initializing MiDaS '{midas_model_type}' depth model...")
    # load network
    midas_model_path = default_models[midas_model_type]

    if midas_model_type == "dpt_large": # DPT-Large
        midas_model = DPTDepthModel(
            path=midas_model_path,
            backbone="vitl16_384",
            non_negative=True,
        )
        net_w, net_h = 384, 384
        resize_mode = "minimal"
        normalization = NormalizeImage(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5])
    elif midas_model_type == "dpt_hybrid": #DPT-Hybrid
        midas_model = DPTDepthModel(
            path=midas_model_path,
            backbone="vitb_rn50_384",
            non_negative=True,
        )
        net_w, net_h = 384, 384
        resize_mode="minimal"
        normalization = NormalizeImage(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5])
    elif midas_model_type == "dpt_hybrid_nyu": #DPT-Hybrid-NYU
        midas_model = DPTDepthModel(
            path=midas_model_path,
            backbone="vitb_rn50_384",
            non_negative=True,
        )
        net_w, net_h = 384, 384
        resize_mode="minimal"
        normalization = NormalizeImage(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5])
    elif midas_model_type == "midas_v21":
        midas_model = MidasNet(midas_model_path, non_negative=True)
        net_w, net_h = 384, 384
        resize_mode="upper_bound"
        normalization = NormalizeImage(
            mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225]
        )
    elif midas_model_type == "midas_v21_small":
        midas_model = MidasNet_small(midas_model_path, features=64, backbone="efficientnet_lite3", exportable=True, non_negative=True, blocks
        net_w, net_h = 256, 256
        resize_mode="upper_bound"
        normalization = NormalizeImage(
            mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225]
        )
    else:
        print(f"midas_model_type '{midas_model_type}' not implemented")
        assert False

    midas_transform = T.Compose(
        [
            Resize(
                net_w,
                net_h,
                resize_target=None,
                keep_aspect_ratio=True,
                ensure_multiple_of=32,
                resize_method=resize_mode,
                image_interpolation_method=cv2.INTER_CUBIC,
            ),
            normalization,
            PrepareForNet(),
        ]
    )

    midas_model.eval()
```

```
    if optimize==True:
        if DEVICE == torch.device("cuda"):
            midas_model = midas_model.to(memory_format=torch.channels_last)
            midas_model = midas_model.half()

    midas_model.to(DEVICE)

    print(f"MiDaS '{midas_model_type}' depth model initialized.")
    return midas_model, midas_transform, net_w, net_h, resize_mode, normalization
```

1.5 Define necessary functions

```
#@title 1.5 Define necessary functions

# https://gist.github.com/adefossez/0646dbe9ed4005480a2407c62aac8869

import py3d_tools as p3dT
import disco_xform_utils as dxf

def interp(t):
    return 3 * t**2 - 2 * t ** 3

def perlin(width, height, scale=10, device=None):
    gx, gy = torch.randn(2, width + 1, height + 1, 1, 1, device=device)
    xs = torch.linspace(0, 1, scale + 1)[:-1, None].to(device)
    ys = torch.linspace(0, 1, scale + 1)[None, :-1].to(device)
    wx = 1 - interp(xs)
    wy = 1 - interp(ys)
    dots = 0
    dots += wx * wy * (gx[:-1, :-1] * xs + gy[:-1, :-1] * ys)
    dots += (1 - wx) * wy * (-gx[1:, :-1] * (1 - xs) + gy[1:, :-1] * ys)
    dots += wx * (1 - wy) * (gx[:-1, 1:] * xs - gy[:-1, 1:] * (1 - ys))
    dots += (1 - wx) * (1 - wy) * (-gx[1:, 1:] * (1 - xs) - gy[1:, 1:] * (1 - ys))
    return dots.permute(0, 2, 1, 3).contiguous().view(width * scale, height * scale)

def perlin_ms(octaves, width, height, grayscale, device=device):
    out_array = [0.5] if grayscale else [0.5, 0.5, 0.5]
    # out_array = [0.0] if grayscale else [0.0, 0.0, 0.0]
    for i in range(1 if grayscale else 3):
        scale = 2 ** len(octaves)
        oct_width = width
        oct_height = height
        for oct in octaves:
            p = perlin(oct_width, oct_height, scale, device)
            out_array[i] += p * oct
            scale //= 2
            oct_width *= 2
            oct_height *= 2
    return torch.cat(out_array)

def create_perlin_noise(octaves=[1, 1, 1, 1], width=2, height=2, grayscale=True):
    out = perlin_ms(octaves, width, height, grayscale)
    if grayscale:
        out = TF.resize(size=(side_y, side_x), img=out.unsqueeze(0))
        out = TF.to_pil_image(out.clamp(0, 1)).convert('RGB')
    else:
        out = out.reshape(-1, 3, out.shape[0]//3, out.shape[1])
        out = TF.resize(size=(side_y, side_x), img=out)
        out = TF.to_pil_image(out.clamp(0, 1).squeeze())

    out = ImageOps.autocontrast(out)
    return out

def regen_perlin():
    if perlin_mode == 'color':
        init = create_perlin_noise([1.5**-i*0.5 for i in range(12)], 1, 1, False)
        init2 = create_perlin_noise([1.5**-i*0.5 for i in range(8)], 4, 4, False)
    elif perlin_mode == 'gray':
        init = create_perlin_noise([1.5**-i*0.5 for i in range(12)], 1, 1, True)
        init2 = create_perlin_noise([1.5**-i*0.5 for i in range(8)], 4, 4, True)
    else:
        init = create_perlin_noise([1.5**-i*0.5 for i in range(12)], 1, 1, False)
        init2 = create_perlin_noise([1.5**-i*0.5 for i in range(8)], 4, 4, True)

    init = TF.to_tensor(init).add(TF.to_tensor(init2)).div(2).to(device).unsqueeze(0).mul(2).sub(1)
    del init2
```

```
    return init.expand(batch_size, -1, -1, -1)

def fetch(url_or_path):
    if str(url_or_path).startswith('http://') or str(url_or_path).startswith('https://'):
        r = requests.get(url_or_path)
        r.raise_for_status()
        fd = io.BytesIO()
        fd.write(r.content)
        fd.seek(0)
        return fd
    return open(url_or_path, 'rb')

def read_image_workaround(path):
    """OpenCV reads images as BGR, Pillow saves them as RGB. Work around
    this incompatibility to avoid colour inversions."""
    im_tmp = cv2.imread(path)
    return cv2.cvtColor(im_tmp, cv2.COLOR_BGR2RGB)

def parse_prompt(prompt):
    if prompt.startswith('http://') or prompt.startswith('https://'):
        vals = prompt.rsplit(':', 2)
        vals = [vals[0] + ':' + vals[1], *vals[2:]]
    else:
        vals = prompt.rsplit(':', 1)
    vals = vals + ['', '1'][len(vals):]
    return vals[0], float(vals[1])

def sinc(x):
    return torch.where(x != 0, torch.sin(math.pi * x) / (math.pi * x), x.new_ones([]))

def lanczos(x, a):
    cond = torch.logical_and(-a < x, x < a)
    out = torch.where(cond, sinc(x) * sinc(x/a), x.new_zeros([]))
    return out / out.sum()

def ramp(ratio, width):
    n = math.ceil(width / ratio + 1)
    out = torch.empty([n])
    cur = 0
    for i in range(out.shape[0]):
        out[i] = cur
        cur += ratio
    return torch.cat([-out[1:].flip([0]), out])[1:-1]

def resample(input, size, align_corners=True):
    n, c, h, w = input.shape
    dh, dw = size

    input = input.reshape([n * c, 1, h, w])

    if dh < h:
        kernel_h = lanczos(ramp(dh / h, 2), 2).to(input.device, input.dtype)
        pad_h = (kernel_h.shape[0] - 1) // 2
        input = F.pad(input, (0, 0, pad_h, pad_h), 'reflect')
        input = F.conv2d(input, kernel_h[None, None, :, None])

    if dw < w:
        kernel_w = lanczos(ramp(dw / w, 2), 2).to(input.device, input.dtype)
        pad_w = (kernel_w.shape[0] - 1) // 2
        input = F.pad(input, (pad_w, pad_w, 0, 0), 'reflect')
        input = F.conv2d(input, kernel_w[None, None, None, :])

    input = input.reshape([n, c, h, w])
    return F.interpolate(input, size, mode='bicubic', align_corners=align_corners)

class MakeCutouts(nn.Module):
    def __init__(self, cut_size, cutn, skip_augs=False):
        super().__init__()
        self.cut_size = cut_size
        self.cutn = cutn
        self.skip_augs = skip_augs
        self.augs = T.Compose([
            T.RandomHorizontalFlip(p=0.5),
            T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
            T.RandomAffine(degrees=15, translate=(0.1, 0.1)),
            T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
            T.RandomPerspective(distortion_scale=0.4, p=0.7),
```

```
            T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
            T.RandomGrayscale(p=0.15),
            T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
            # T.ColorJitter(brightness=0.1, contrast=0.1, saturation=0.1, hue=0.1),
        ])

    def forward(self, input):
        input = T.Pad(input.shape[2]//4, fill=0)(input)
        sideY, sideX = input.shape[2:4]
        max_size = min(sideX, sideY)

        cutouts = []
        for ch in range(self.cutn):
            if ch > self.cutn - self.cutn//4:
                cutout = input.clone()
            else:
                size = int(max_size * torch.zeros(1,).normal_(mean=.8, std=.3).clip(float(self.cut_size/max_size), 1.))
                offsetx = torch.randint(0, abs(sideX - size + 1), ())
                offsety = torch.randint(0, abs(sideY - size + 1), ())
                cutout = input[:, :, offsety:offsety + size, offsetx:offsetx + size]

            if not self.skip_augs:
                cutout = self.augs(cutout)
            cutouts.append(resample(cutout, (self.cut_size, self.cut_size)))
            del cutout

        cutouts = torch.cat(cutouts, dim=0)
        return cutouts

cutout_debug = False
padargs = {}

class MakeCutoutsDango(nn.Module):
    def __init__(self, cut_size,
                 Overview=4,
                 InnerCrop = 0, IC_Size_Pow=0.5, IC_Grey_P = 0.2
                 ):
        super().__init__()
        self.cut_size = cut_size
        self.Overview = Overview
        self.InnerCrop = InnerCrop
        self.IC_Size_Pow = IC_Size_Pow
        self.IC_Grey_P = IC_Grey_P
        if args.animation_mode == 'None':
          self.augs = T.Compose([
              T.RandomHorizontalFlip(p=0.5),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomAffine(degrees=10, translate=(0.05, 0.05),  interpolation = T.InterpolationMode.BILINEAR),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomGrayscale(p=0.1),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.ColorJitter(brightness=0.1, contrast=0.1, saturation=0.1, hue=0.1),
          ])
        elif args.animation_mode == 'Video Input':
          self.augs = T.Compose([
              T.RandomHorizontalFlip(p=0.5),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomAffine(degrees=15, translate=(0.1, 0.1)),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomPerspective(distortion_scale=0.4, p=0.7),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomGrayscale(p=0.15),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              # T.ColorJitter(brightness=0.1, contrast=0.1, saturation=0.1, hue=0.1),
          ])
        elif  args.animation_mode == '2D' or args.animation_mode == '3D':
          self.augs = T.Compose([
              T.RandomHorizontalFlip(p=0.4),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomAffine(degrees=10, translate=(0.05, 0.05),  interpolation = T.InterpolationMode.BILINEAR),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.RandomGrayscale(p=0.1),
              T.Lambda(lambda x: x + torch.randn_like(x) * 0.01),
              T.ColorJitter(brightness=0.1, contrast=0.1, saturation=0.1, hue=0.3),
          ])
```

```
    def forward(self, input):
        cutouts = []
        gray = T.Grayscale(3)
        sideY, sideX = input.shape[2:4]
        max_size = min(sideX, sideY)
        min_size = min(sideX, sideY, self.cut_size)
        l_size = max(sideX, sideY)
        output_shape = [1,3,self.cut_size,self.cut_size]
        output_shape_2 = [1,3,self.cut_size+2,self.cut_size+2]
        pad_input = F.pad(input,((sideY-max_size)//2,(sideY-max_size)//2,(sideX-max_size)//2,(sideX-max_size)//2), **padargs)
        cutout = resize(pad_input, out_shape=output_shape)

        if self.Overview>0:
            if self.Overview<=4:
                if self.Overview>=1:
                    cutouts.append(cutout)
                if self.Overview>=2:
                    cutouts.append(gray(cutout))
                if self.Overview>=3:
                    cutouts.append(TF.hflip(cutout))
                if self.Overview==4:
                    cutouts.append(gray(TF.hflip(cutout)))
            else:
                cutout = resize(pad_input, out_shape=output_shape)
                for _ in range(self.Overview):
                    cutouts.append(cutout)

            if cutout_debug:
                if is_colab:
                    TF.to_pil_image(cutouts[0].clamp(0, 1).squeeze(0)).save("/content/cutout_overview0.jpg",quality=99)
                else:
                    TF.to_pil_image(cutouts[0].clamp(0, 1).squeeze(0)).save("cutout_overview0.jpg",quality=99)


        if self.InnerCrop >0:
            for i in range(self.InnerCrop):
                size = int(torch.rand([])**self.IC_Size_Pow * (max_size - min_size) + min_size)
                offsetx = torch.randint(0, sideX - size + 1, ())
                offsety = torch.randint(0, sideY - size + 1, ())
                cutout = input[:, :, offsety:offsety + size, offsetx:offsetx + size]
                if i <= int(self.IC_Grey_P * self.InnerCrop):
                    cutout = gray(cutout)
                cutout = resize(cutout, out_shape=output_shape)
                cutouts.append(cutout)
            if cutout_debug:
                if is_colab:
                    TF.to_pil_image(cutouts[-1].clamp(0, 1).squeeze(0)).save("/content/cutout_InnerCrop.jpg",quality=99)
                else:
                    TF.to_pil_image(cutouts[-1].clamp(0, 1).squeeze(0)).save("cutout_InnerCrop.jpg",quality=99)
        cutouts = torch.cat(cutouts)
        if skip_augs is not True: cutouts=self.augs(cutouts)
        return cutouts

def spherical_dist_loss(x, y):
    x = F.normalize(x, dim=-1)
    y = F.normalize(y, dim=-1)
    return (x - y).norm(dim=-1).div(2).arcsin().pow(2).mul(2)

def tv_loss(input):
    """L2 total variation loss, as in Mahendran et al."""
    input = F.pad(input, (0, 1, 0, 1), 'replicate')
    x_diff = input[..., :-1, 1:] - input[..., :-1, :-1]
    y_diff = input[..., 1:, :-1] - input[..., :-1, :-1]
    return (x_diff**2 + y_diff**2).mean([1, 2, 3])


def range_loss(input):
    return (input - input.clamp(-1, 1)).pow(2).mean([1, 2, 3])

stop_on_next_loop = False  # Make sure GPU memory doesn't get corrupted from cancelling the run mid-way through, allow a full frame to comple
TRANSLATION_SCALE = 1.0/200.0

def do_3d_step(img_filepath, frame_num, midas_model, midas_transform):
  if args.key_frames:
    translation_x = args.translation_x_series[frame_num]
    translation_y = args.translation_y_series[frame_num]
    translation_z = args.translation_z_series[frame_num]
```

```
    rotation_3d_x = args.rotation_3d_x_series[frame_num]
    rotation_3d_y = args.rotation_3d_y_series[frame_num]
    rotation_3d_z = args.rotation_3d_z_series[frame_num]
    print(
        f'translation_x: {translation_x}',
        f'translation_y: {translation_y}',
        f'translation_z: {translation_z}',
        f'rotation_3d_x: {rotation_3d_x}',
        f'rotation_3d_y: {rotation_3d_y}',
        f'rotation_3d_z: {rotation_3d_z}',
    )

  translate_xyz = [-translation_x*TRANSLATION_SCALE, translation_y*TRANSLATION_SCALE, -translation_z*TRANSLATION_SCALE]
  rotate_xyz_degrees = [rotation_3d_x, rotation_3d_y, rotation_3d_z]
  print('translation:',translate_xyz)
  print('rotation:',rotate_xyz_degrees)
  rotate_xyz = [math.radians(rotate_xyz_degrees[0]), math.radians(rotate_xyz_degrees[1]), math.radians(rotate_xyz_degrees[2])]
  rot_mat = p3dT.euler_angles_to_matrix(torch.tensor(rotate_xyz, device=device), "XYZ").unsqueeze(0)
  print("rot_mat: " + str(rot_mat))
  next_step_pil = dxf.transform_image_3d(img_filepath, midas_model, midas_transform, DEVICE,
                                         rot_mat, translate_xyz, args.near_plane, args.far_plane,
                                         args.fov, padding_mode=args.padding_mode,
                                         sampling_mode=args.sampling_mode, midas_weight=args.midas_weight)
  return next_step_pil

def symmetry_transformation_fn(x):
    if args.use_horizontal_symmetry:
        [n, c, h, w] = x.size()
        x = torch.concat((x[:, :, :, :w//2], torch.flip(x[:, :, :, :w//2], [-1])), -1)
        print("horizontal symmetry applied")
    if args.use_vertical_symmetry:
        [n, c, h, w] = x.size()
        x = torch.concat((x[:, :, :h//2, :], torch.flip(x[:, :, :h//2, :], [-2])), -2)
        print("vertical symmetry applied")
    return x

def do_run():
  seed = args.seed
  print(range(args.start_frame, args.max_frames))

  if (args.animation_mode == "3D") and (args.midas_weight > 0.0):
      midas_model, midas_transform, midas_net_w, midas_net_h, midas_resize_mode, midas_normalization = init_midas_depth_model(args.midas_dept
  for frame_num in range(args.start_frame, args.max_frames):
      if stop_on_next_loop:
        break

      display.clear_output(wait=True)

      # Print Frame progress if animation mode is on
      if args.animation_mode != "None":
        batchBar = tqdm(range(args.max_frames), desc ="Frames")
        batchBar.n = frame_num
        batchBar.refresh()


      # Inits if not video frames
      if args.animation_mode != "Video Input":
        if args.init_image in ['','none', 'None', 'NONE']:
          init_image = None
        else:
          init_image = args.init_image
        init_scale = args.init_scale
        skip_steps = args.skip_steps

      if args.animation_mode == "2D":
        if args.key_frames:
          angle = args.angle_series[frame_num]
          zoom = args.zoom_series[frame_num]
          translation_x = args.translation_x_series[frame_num]
          translation_y = args.translation_y_series[frame_num]
          print(
              f'angle: {angle}',
              f'zoom: {zoom}',
              f'translation_x: {translation_x}',
              f'translation_y: {translation_y}',
          )
```

```
        if frame_num > 0:
          seed += 1
          if resume_run and frame_num == start_frame:
            img_0 = cv2.imread(batchFolder+f"/{batch_name}({batchNum})_{start_frame-1:04}.png")
          else:
            img_0 = cv2.imread('prevFrame.png')
          center = (1*img_0.shape[1]//2, 1*img_0.shape[0]//2)
          trans_mat = np.float32(
              [[1, 0, translation_x],
              [0, 1, translation_y]]
          )
          rot_mat = cv2.getRotationMatrix2D( center, angle, zoom )
          trans_mat = np.vstack([trans_mat, [0,0,1]])
          rot_mat = np.vstack([rot_mat, [0,0,1]])
          transformation_matrix = np.matmul(rot_mat, trans_mat)
          img_0 = cv2.warpPerspective(
              img_0,
              transformation_matrix,
              (img_0.shape[1], img_0.shape[0]),
              borderMode=cv2.BORDER_WRAP
          )

          cv2.imwrite('prevFrameScaled.png', img_0)
          init_image = 'prevFrameScaled.png'
          init_scale = args.frames_scale
          skip_steps = args.calc_frames_skip_steps

      if args.animation_mode == "3D":
        if frame_num > 0:
          seed += 1
          if resume_run and frame_num == start_frame:
            img_filepath = batchFolder+f"/{batch_name}({batchNum})_{start_frame-1:04}.png"
            if turbo_mode and frame_num > turbo_preroll:
              shutil.copyfile(img_filepath, 'oldFrameScaled.png')
          else:
            img_filepath = '/content/prevFrame.png' if is_colab else 'prevFrame.png'

          next_step_pil = do_3d_step(img_filepath, frame_num, midas_model, midas_transform)
          next_step_pil.save('prevFrameScaled.png')

          ### Turbo mode - skip some diffusions, use 3d morph for clarity and to save time
          if turbo_mode:
            if frame_num == turbo_preroll: #start tracking oldframe
              next_step_pil.save('oldFrameScaled.png')#stash for later blending
            elif frame_num > turbo_preroll:
              #set up 2 warped image sequences, old & new, to blend toward new diff image
              old_frame = do_3d_step('oldFrameScaled.png', frame_num, midas_model, midas_transform)
              old_frame.save('oldFrameScaled.png')
              if frame_num % int(turbo_steps) != 0:
                print('turbo skip this frame: skipping clip diffusion steps')
                filename = f'{args.batch_name}({args.batchNum})_{frame_num:04}.png'
                blend_factor = ((frame_num % int(turbo_steps))+1)/int(turbo_steps)
                print('turbo skip this frame: skipping clip diffusion steps and saving blended frame')
                newWarpedImg = cv2.imread('prevFrameScaled.png')#this is already updated..
                oldWarpedImg = cv2.imread('oldFrameScaled.png')
                blendedImage = cv2.addWeighted(newWarpedImg, blend_factor, oldWarpedImg,1-blend_factor, 0.0)
                cv2.imwrite(f'{batchFolder}/{filename}',blendedImage)
                next_step_pil.save(f'{img_filepath}') # save it also as prev_frame to feed next iteration
                if vr_mode:
                  generate_eye_views(TRANSLATION_SCALE,batchFolder,filename,frame_num,midas_model, midas_transform)
                continue
              else:
                #if not a skip frame, will run diffusion and need to blend.
                oldWarpedImg = cv2.imread('prevFrameScaled.png')
                cv2.imwrite(f'oldFrameScaled.png',oldWarpedImg)#swap in for blending later
                print('clip/diff this frame - generate clip diff image')

          init_image = 'prevFrameScaled.png'
          init_scale = args.frames_scale
          skip_steps = args.calc_frames_skip_steps

      if  args.animation_mode == "Video Input":
        init_scale = args.video_init_frames_scale
        skip_steps = args.calc_frames_skip_steps
        if not video_init_seed_continuity:
          seed += 1
        if video_init_flow_warp:
```

```
      if frame_num == 0:
        skip_steps = args.video_init_skip_steps
        init_image = f'{videoFramesFolder}/{frame_num+1:04}.jpg'
      if frame_num > 0:
        prev = PIL.Image.open(batchFolder+f"/{batch_name}({batchNum})_{frame_num-1:04}.png")

        frame1_path = f'{videoFramesFolder}/{frame_num:04}.jpg'
        frame2 = PIL.Image.open(f'{videoFramesFolder}/{frame_num+1:04}.jpg')
        flo_path = f"/{flo_folder}/{frame1_path.split('/')[-1]}.npy"

        init_image = 'warped.png'
        print(video_init_flow_blend)
        weights_path = None
        if video_init_check_consistency:
            # TBD
            pass

        warp(prev, frame2, flo_path, blend=video_init_flow_blend, weights_path=weights_path).save(init_image)

    else:
      init_image = f'{videoFramesFolder}/{frame_num+1:04}.jpg'


loss_values = []

if seed is not None:
    np.random.seed(seed)
    random.seed(seed)
    torch.manual_seed(seed)
    torch.cuda.manual_seed_all(seed)
    torch.backends.cudnn.deterministic = True

target_embeds, weights = [], []

if args.prompts_series is not None and frame_num >= len(args.prompts_series):
  frame_prompt = args.prompts_series[-1]
elif args.prompts_series is not None:
  frame_prompt = args.prompts_series[frame_num]
else:
  frame_prompt = []

print(args.image_prompts_series)
if args.image_prompts_series is not None and frame_num >= len(args.image_prompts_series):
  image_prompt = args.image_prompts_series[-1]
elif args.image_prompts_series is not None:
  image_prompt = args.image_prompts_series[frame_num]
else:
  image_prompt = []

print(f'Frame {frame_num} Prompt: {frame_prompt}')

model_stats = []
for clip_model in clip_models:
      cutn = 16
      model_stat = {"clip_model":None,"target_embeds":[],"make_cutouts":None,"weights":[]}
      model_stat["clip_model"] = clip_model

      for prompt in frame_prompt:
          txt, weight = parse_prompt(prompt)
          txt = clip_model.encode_text(clip.tokenize(prompt).to(device)).float()

          if args.fuzzy_prompt:
              for i in range(25):
                  model_stat["target_embeds"].append((txt + torch.randn(txt.shape).cuda() * args.rand_mag).clamp(0,1))
                  model_stat["weights"].append(weight)
          else:
              model_stat["target_embeds"].append(txt)
              model_stat["weights"].append(weight)

      if image_prompt:
        model_stat["make_cutouts"] = MakeCutouts(clip_model.visual.input_resolution, cutn, skip_augs=skip_augs)
        for prompt in image_prompt:
            path, weight = parse_prompt(prompt)
            img = Image.open(fetch(path)).convert('RGB')
            img = TF.resize(img, min(side_x, side_y, *img.size), T.InterpolationMode.LANCZOS)
            batch = model_stat["make_cutouts"](TF.to_tensor(img).to(device).unsqueeze(0).mul(2).sub(1))
            embed = clip_model.encode_image(normalize(batch)).float()
```

```
                if fuzzy_prompt:
                    for i in range(25):
                        model_stat["target_embeds"].append((embed + torch.randn(embed.shape).cuda() * rand_mag).clamp(0,1))
                        weights.extend([weight / cutn] * cutn)
                else:
                    model_stat["target_embeds"].append(embed)
                    model_stat["weights"].extend([weight / cutn] * cutn)

        model_stat["target_embeds"] = torch.cat(model_stat["target_embeds"])
        model_stat["weights"] = torch.tensor(model_stat["weights"], device=device)
        if model_stat["weights"].sum().abs() < 1e-3:
            raise RuntimeError('The weights must not sum to 0.')
        model_stat["weights"] /= model_stat["weights"].sum().abs()
        model_stats.append(model_stat)

    init = None
    if init_image is not None:
        init = Image.open(fetch(init_image)).convert('RGB')
        init = init.resize((args.side_x, args.side_y), Image.LANCZOS)
        init = TF.to_tensor(init).to(device).unsqueeze(0).mul(2).sub(1)

    if args.perlin_init:
        if args.perlin_mode == 'color':
            init = create_perlin_noise([1.5**-i*0.5 for i in range(12)], 1, 1, False)
            init2 = create_perlin_noise([1.5**-i*0.5 for i in range(8)], 4, 4, False)
        elif args.perlin_mode == 'gray':
          init = create_perlin_noise([1.5**-i*0.5 for i in range(12)], 1, 1, True)
          init2 = create_perlin_noise([1.5**-i*0.5 for i in range(8)], 4, 4, True)
        else:
          init = create_perlin_noise([1.5**-i*0.5 for i in range(12)], 1, 1, False)
          init2 = create_perlin_noise([1.5**-i*0.5 for i in range(8)], 4, 4, True)
        # init = TF.to_tensor(init).add(TF.to_tensor(init2)).div(2).to(device)
        init = TF.to_tensor(init).add(TF.to_tensor(init2)).div(2).to(device).unsqueeze(0).mul(2).sub(1)
        del init2

    cur_t = None

    def cond_fn(x, t, y=None):
        with torch.enable_grad():
            x_is_NaN = False
            x = x.detach().requires_grad_()
            n = x.shape[0]
            if use_secondary_model is True:
              alpha = torch.tensor(diffusion.sqrt_alphas_cumprod[cur_t], device=device, dtype=torch.float32)
              sigma = torch.tensor(diffusion.sqrt_one_minus_alphas_cumprod[cur_t], device=device, dtype=torch.float32)
              cosine_t = alpha_sigma_to_t(alpha, sigma)
              out = secondary_model(x, cosine_t[None].repeat([n])).pred
              fac = diffusion.sqrt_one_minus_alphas_cumprod[cur_t]
              x_in = out * fac + x * (1 - fac)
              x_in_grad = torch.zeros_like(x_in)
            else:
              my_t = torch.ones([n], device=device, dtype=torch.long) * cur_t
              out = diffusion.p_mean_variance(model, x, my_t, clip_denoised=False, model_kwargs={'y': y})
              fac = diffusion.sqrt_one_minus_alphas_cumprod[cur_t]
              x_in = out['pred_xstart'] * fac + x * (1 - fac)
              x_in_grad = torch.zeros_like(x_in)
            for model_stat in model_stats:
              for i in range(args.cutn_batches):
                  t_int = int(t.item())+1 #errors on last step without +1, need to find source
                  #when using SLIP Base model the dimensions need to be hard coded to avoid AttributeError: 'VisionTransformer' object has
                  try:
                      input_resolution=model_stat["clip_model"].visual.input_resolution
                  except:
                      input_resolution=224

                  cuts = MakeCutoutsDango(input_resolution,
                          Overview= args.cut_overview[1000-t_int],
                          InnerCrop = args.cut_innercut[1000-t_int],
                          IC_Size_Pow=args.cut_ic_pow[1000-t_int],
                          IC_Grey_P = args.cut_icgray_p[1000-t_int]
                          )
                  clip_in = normalize(cuts(x_in.add(1).div(2)))
                  image_embeds = model_stat["clip_model"].encode_image(clip_in).float()
                  dists = spherical_dist_loss(image_embeds.unsqueeze(1), model_stat["target_embeds"].unsqueeze(0))
                  dists = dists.view([args.cut_overview[1000-t_int]+args.cut_innercut[1000-t_int], n, -1])
                  losses = dists.mul(model_stat["weights"]).sum(2).mean(0)
                  loss_values.append(losses.sum().item()) # log loss, probably shouldn't do per cutn_batch
```

```
                x_in_grad += torch.autograd.grad(losses.sum() * clip_guidance_scale, x_in)[0] / cutn_batches
            tv_losses = tv_loss(x_in)
            if use_secondary_model is True:
              range_losses = range_loss(out)
            else:
              range_losses = range_loss(out['pred_xstart'])
            sat_losses = torch.abs(x_in - x_in.clamp(min=-1,max=1)).mean()
            loss = tv_losses.sum() * tv_scale + range_losses.sum() * range_scale + sat_losses.sum() * sat_scale
            if init is not None and init_scale:
                init_losses = lpips_model(x_in, init)
                loss = loss + init_losses.sum() * init_scale
            x_in_grad += torch.autograd.grad(loss, x_in)[0]
            if torch.isnan(x_in_grad).any()==False:
                grad = -torch.autograd.grad(x_in, x, x_in_grad)[0]
            else:
              # print("NaN'd")
              x_is_NaN = True
              grad = torch.zeros_like(x)
        if args.clamp_grad and x_is_NaN == False:
            magnitude = grad.square().mean().sqrt()
            return grad * magnitude.clamp(max=args.clamp_max) / magnitude  #min=-0.02, min=-clamp_max,
        return grad

    if args.diffusion_sampling_mode == 'ddim':
        sample_fn = diffusion.ddim_sample_loop_progressive
    else:
        sample_fn = diffusion.plms_sample_loop_progressive


    image_display = Output()
    for i in range(args.n_batches):
        if args.animation_mode == 'None':
          display.clear_output(wait=True)
          batchBar = tqdm(range(args.n_batches), desc ="Batches")
          batchBar.n = i
          batchBar.refresh()
        print('')
        display.display(image_display)
        gc.collect()
        torch.cuda.empty_cache()
        cur_t = diffusion.num_timesteps - skip_steps - 1
        total_steps = cur_t

        if perlin_init:
            init = regen_perlin()

        if args.diffusion_sampling_mode == 'ddim':
            samples = sample_fn(
                model,
                (batch_size, 3, args.side_y, args.side_x),
                clip_denoised=clip_denoised,
                model_kwargs={},
                cond_fn=cond_fn,
                progress=True,
                skip_timesteps=skip_steps,
                init_image=init,
                randomize_class=randomize_class,
                eta=eta,
                transformation_fn=symmetry_transformation_fn,
                transformation_percent=args.transformation_percent
            )
        else:
            samples = sample_fn(
                model,
                (batch_size, 3, args.side_y, args.side_x),
                clip_denoised=clip_denoised,
                model_kwargs={},
                cond_fn=cond_fn,
                progress=True,
                skip_timesteps=skip_steps,
                init_image=init,
                randomize_class=randomize_class,
                order=2,
            )


        # with run_display:
```

```
          # display.clear_output(wait=True)
          for j, sample in enumerate(samples):
            cur_t -= 1
            intermediateStep = False
            if args.steps_per_checkpoint is not None:
                if j % steps_per_checkpoint == 0 and j > 0:
                  intermediateStep = True
            elif j in args.intermediate_saves:
              intermediateStep = True
            with image_display:
              if j % args.display_rate == 0 or cur_t == -1 or intermediateStep == True:
                  for k, image in enumerate(sample['pred_xstart']):
                      # tqdm.write(f'Batch {i}, step {j}, output {k}:')
                      current_time = datetime.now().strftime('%y%m%d-%H%M%S_%f')
                      percent = math.ceil(j/total_steps*100)
                      if args.n_batches > 0:
                        #if intermediates are saved to the subfolder, don't append a step or percentage to the name
                        if cur_t == -1 and args.intermediates_in_subfolder is True:
                          save_num = f'{frame_num:04}' if animation_mode != "None" else i
                          filename = f'{args.batch_name}({args.batchNum})_{save_num}.png'
                        else:
                          #If we're working with percentages, append it
                          if args.steps_per_checkpoint is not None:
                            filename = f'{args.batch_name}({args.batchNum})_{i:04}-{percent:02}%.png'
                          # Or else, iIf we're working with specific steps, append those
                          else:
                            filename = f'{args.batch_name}({args.batchNum})_{i:04}-{j:03}.png'
                      image = TF.to_pil_image(image.add(1).div(2).clamp(0, 1))
                      if j % args.display_rate == 0 or cur_t == -1:
                        image.save('progress.png')
                        display.clear_output(wait=True)
                        display.display(display.Image('progress.png'))
                      if args.steps_per_checkpoint is not None:
                        if j % args.steps_per_checkpoint == 0 and j > 0:
                          if args.intermediates_in_subfolder is True:
                            image.save(f'{partialFolder}/{filename}')
                          else:
                            image.save(f'{batchFolder}/{filename}')
                      else:
                        if j in args.intermediate_saves:
                          if args.intermediates_in_subfolder is True:
                            image.save(f'{partialFolder}/{filename}')
                          else:
                            image.save(f'{batchFolder}/{filename}')
                      if cur_t == -1:
                        if frame_num == 0:
                          save_settings()
                        if args.animation_mode != "None":
                          image.save('prevFrame.png')
                        image.save(f'{batchFolder}/{filename}')
                        if args.animation_mode == "3D":
                          # If turbo, save a blended image
                          if turbo_mode and frame_num > 0:
                            # Mix new image with prevFrameScaled
                            blend_factor = (1)/int(turbo_steps)
                            newFrame = cv2.imread('prevFrame.png') # This is already updated..
                            prev_frame_warped = cv2.imread('prevFrameScaled.png')
                            blendedImage = cv2.addWeighted(newFrame, blend_factor, prev_frame_warped, (1-blend_factor), 0.0)
                            cv2.imwrite(f'{batchFolder}/{filename}',blendedImage)
                          else:
                            image.save(f'{batchFolder}/{filename}')

                          if vr_mode:
                            generate_eye_views(TRANSLATION_SCALE, batchFolder, filename, frame_num, midas_model, midas_transform)

                        # if frame_num != args.max_frames-1:
                        #   display.clear_output()

          plt.plot(np.array(loss_values), 'r')

def generate_eye_views(trans_scale,batchFolder,filename,frame_num,midas_model, midas_transform):
   for i in range(2):
      theta = vr_eye_angle * (math.pi/180)
      ray_origin = math.cos(theta) * vr_ipd / 2 * (-1.0 if i==0 else 1.0)
      ray_rotation = (theta if i==0 else -theta)
      translate_xyz = [-(ray_origin)*trans_scale, 0,0]
      rotate_xyz = [0, (ray_rotation), 0]
```

```
      rot_mat = p3dT.euler_angles_to_matrix(torch.tensor(rotate_xyz, device=device), "XYZ").unsqueeze(0)
      transformed_image = dxf.transform_image_3d(f'{batchFolder}/{filename}', midas_model, midas_transform, DEVICE,
                                                 rot_mat, translate_xyz, args.near_plane, args.far_plane,
                                                 args.fov, padding_mode=args.padding_mode,
                                                 sampling_mode=args.sampling_mode, midas_weight=args.midas_weight,spherical=True)
      eye_file_path = batchFolder+f"/frame_{frame_num:04}" + ('_l' if i==0 else '_r')+'.png'
      transformed_image.save(eye_file_path)

def save_settings():
    setting_list = {
      'text_prompts': text_prompts,
      'image_prompts': image_prompts,
      'clip_guidance_scale': clip_guidance_scale,
      'tv_scale': tv_scale,
      'range_scale': range_scale,
      'sat_scale': sat_scale,
      # 'cutn': cutn,
      'cutn_batches': cutn_batches,
      'max_frames': max_frames,
      'interp_spline': interp_spline,
      # 'rotation_per_frame': rotation_per_frame,
      'init_image': init_image,
      'init_scale': init_scale,
      'skip_steps': skip_steps,
      # 'zoom_per_frame': zoom_per_frame,
      'frames_scale': frames_scale,
      'frames_skip_steps': frames_skip_steps,
      'perlin_init': perlin_init,
      'perlin_mode': perlin_mode,
      'skip_augs': skip_augs,
      'randomize_class': randomize_class,
      'clip_denoised': clip_denoised,
      'clamp_grad': clamp_grad,
      'clamp_max': clamp_max,
      'seed': seed,
      'fuzzy_prompt': fuzzy_prompt,
      'rand_mag': rand_mag,
      'eta': eta,
      'width': width_height[0],
      'height': width_height[1],
      'diffusion_model': diffusion_model,
      'use_secondary_model': use_secondary_model,
      'steps': steps,
      'diffusion_steps': diffusion_steps,
      'diffusion_sampling_mode': diffusion_sampling_mode,
      'ViTB32': ViTB32,
      'ViTB16': ViTB16,
      'ViTL14': ViTL14,
      'ViTL14_336px': ViTL14_336px,
      'RN101': RN101,
      'RN50': RN50,
      'RN50x4': RN50x4,
      'RN50x16': RN50x16,
      'RN50x64': RN50x64,
      'ViTB32_laion2b_e16': ViTB32_laion2b_e16,
      'ViTB32_laion400m_e31': ViTB32_laion400m_e31,
      'ViTB32_laion400m_32': ViTB32_laion400m_32,
      'ViTB32quickgelu_laion400m_e31': ViTB32quickgelu_laion400m_e31,
      'ViTB32quickgelu_laion400m_e32': ViTB32quickgelu_laion400m_e32,
      'ViTB16_laion400m_e31': ViTB16_laion400m_e31,
      'ViTB16_laion400m_e32': ViTB16_laion400m_e32,
      'RN50_yffcc15m': RN50_yffcc15m,
      'RN50_cc12m': RN50_cc12m,
      'RN50_quickgelu_yfcc15m': RN50_quickgelu_yfcc15m,
      'RN50_quickgelu_cc12m': RN50_quickgelu_cc12m,
      'RN101_yfcc15m': RN101_yfcc15m,
      'RN101_quickgelu_yfcc15m': RN101_quickgelu_yfcc15m,
      'cut_overview': str(cut_overview),
      'cut_innercut': str(cut_innercut),
      'cut_ic_pow': str(cut_ic_pow),
      'cut_icgray_p': str(cut_icgray_p),
      'key_frames': key_frames,
      'max_frames': max_frames,
      'angle': angle,
      'zoom': zoom,
      'translation_x': translation_x,
      'translation_y': translation_y,
```

```
      'translation_z': translation_z,
      'rotation_3d_x': rotation_3d_x,
      'rotation_3d_y': rotation_3d_y,
      'rotation_3d_z': rotation_3d_z,
      'midas_depth_model': midas_depth_model,
      'midas_weight': midas_weight,
      'near_plane': near_plane,
      'far_plane': far_plane,
      'fov': fov,
      'padding_mode': padding_mode,
      'sampling_mode': sampling_mode,
      'video_init_path':video_init_path,
      'extract_nth_frame':extract_nth_frame,
      'video_init_seed_continuity': video_init_seed_continuity,
      'turbo_mode':turbo_mode,
      'turbo_steps':turbo_steps,
      'turbo_preroll':turbo_preroll,
      'use_horizontal_symmetry':use_horizontal_symmetry,
      'use_vertical_symmetry':use_vertical_symmetry,
      'transformation_percent':transformation_percent,
      #video init settings
      'video_init_steps': video_init_steps,
      'video_init_clip_guidance_scale': video_init_clip_guidance_scale,
      'video_init_tv_scale': video_init_tv_scale,
      'video_init_range_scale': video_init_range_scale,
      'video_init_sat_scale': video_init_sat_scale,
      'video_init_cutn_batches': video_init_cutn_batches,
      'video_init_skip_steps': video_init_skip_steps,
      'video_init_frames_scale': video_init_frames_scale,
      'video_init_frames_skip_steps': video_init_frames_skip_steps,
      #warp settings
      'video_init_flow_warp':video_init_flow_warp,
      'video_init_flow_blend':video_init_flow_blend,
      'video_init_check_consistency':video_init_check_consistency,
      'video_init_blend_mode':video_init_blend_mode
    }
```

1.6 Define the secondary diffusion model

```
#@title 1.6 Define the secondary diffusion model

def append_dims(x, n):
    return x[(Ellipsis, *(None,) * (n - x.ndim))]


def expand_to_planes(x, shape):
    return append_dims(x, len(shape)).repeat([1, 1, *shape[2:]])


def alpha_sigma_to_t(alpha, sigma):
    return torch.atan2(sigma, alpha) * 2 / math.pi


def t_to_alpha_sigma(t):
    return torch.cos(t * math.pi / 2), torch.sin(t * math.pi / 2)


@dataclass
class DiffusionOutput:
    v: torch.Tensor
    pred: torch.Tensor
    eps: torch.Tensor


class ConvBlock(nn.Sequential):
    def __init__(self, c_in, c_out):
        super().__init__(
            nn.Conv2d(c_in, c_out, 3, padding=1),
            nn.ReLU(inplace=True),
        )


class SkipBlock(nn.Module):
    def __init__(self, main, skip=None):
        super().__init__()
        self.main = nn.Sequential(*main)
```

```
        self.skip = skip if skip else nn.Identity()

    def forward(self, input):
        return torch.cat([self.main(input), self.skip(input)], dim=1)


class FourierFeatures(nn.Module):
    def __init__(self, in_features, out_features, std=1.):
        super().__init__()
        assert out_features % 2 == 0
        self.weight = nn.Parameter(torch.randn([out_features // 2, in_features]) * std)

    def forward(self, input):
        f = 2 * math.pi * input @ self.weight.T
        return torch.cat([f.cos(), f.sin()], dim=-1)


class SecondaryDiffusionImageNet(nn.Module):
    def __init__(self):
        super().__init__()
        c = 64  # The base channel count

        self.timestep_embed = FourierFeatures(1, 16)

        self.net = nn.Sequential(
            ConvBlock(3 + 16, c),
            ConvBlock(c, c),
            SkipBlock([
                nn.AvgPool2d(2),
                ConvBlock(c, c * 2),
                ConvBlock(c * 2, c * 2),
                SkipBlock([
                    nn.AvgPool2d(2),
                    ConvBlock(c * 2, c * 4),
                    ConvBlock(c * 4, c * 4),
                    SkipBlock([
                        nn.AvgPool2d(2),
                        ConvBlock(c * 4, c * 8),
                        ConvBlock(c * 8, c * 4),
                        nn.Upsample(scale_factor=2, mode='bilinear', align_corners=False),
                    ]),
                    ConvBlock(c * 8, c * 4),
                    ConvBlock(c * 4, c * 2),
                    nn.Upsample(scale_factor=2, mode='bilinear', align_corners=False),
                ]),
                ConvBlock(c * 4, c * 2),
                ConvBlock(c * 2, c),
                nn.Upsample(scale_factor=2, mode='bilinear', align_corners=False),
            ]),
            ConvBlock(c * 2, c),
            nn.Conv2d(c, 3, 3, padding=1),
        )

    def forward(self, input, t):
        timestep_embed = expand_to_planes(self.timestep_embed(t[:, None]), input.shape)
        v = self.net(torch.cat([input, timestep_embed], dim=1))
        alphas, sigmas = map(partial(append_dims, n=v.ndim), t_to_alpha_sigma(t))
        pred = input * alphas - v * sigmas
        eps = input * sigmas + v * alphas
        return DiffusionOutput(v, pred, eps)


class SecondaryDiffusionImageNet2(nn.Module):
    def __init__(self):
        super().__init__()
        c = 64  # The base channel count
        cs = [c, c * 2, c * 2, c * 4, c * 4, c * 8]

        self.timestep_embed = FourierFeatures(1, 16)
        self.down = nn.AvgPool2d(2)
        self.up = nn.Upsample(scale_factor=2, mode='bilinear', align_corners=False)

        self.net = nn.Sequential(
            ConvBlock(3 + 16, cs[0]),
            ConvBlock(cs[0], cs[0]),
            SkipBlock([
                self.down,
```

```
                ConvBlock(cs[0], cs[1]),
                ConvBlock(cs[1], cs[1]),
                SkipBlock([
                    self.down,
                    ConvBlock(cs[1], cs[2]),
                    ConvBlock(cs[2], cs[2]),
                    SkipBlock([
                        self.down,
                        ConvBlock(cs[2], cs[3]),
                        ConvBlock(cs[3], cs[3]),
                        SkipBlock([
                            self.down,
                            ConvBlock(cs[3], cs[4]),
                            ConvBlock(cs[4], cs[4]),
                            SkipBlock([
                                self.down,
                                ConvBlock(cs[4], cs[5]),
                                ConvBlock(cs[5], cs[5]),
                                ConvBlock(cs[5], cs[5]),
                                ConvBlock(cs[5], cs[4]),
                                self.up,
                            ]),
                            ConvBlock(cs[4] * 2, cs[4]),
                            ConvBlock(cs[4], cs[3]),
                            self.up,
                        ]),
                        ConvBlock(cs[3] * 2, cs[3]),
                        ConvBlock(cs[3], cs[2]),
                        self.up,
                    ]),
                    ConvBlock(cs[2] * 2, cs[2]),
                    ConvBlock(cs[2], cs[1]),
                    self.up,
                ]),
                ConvBlock(cs[1] * 2, cs[1]),
                ConvBlock(cs[1], cs[0]),
                self.up,
            ]),
            ConvBlock(cs[0] * 2, cs[0]),
            nn.Conv2d(cs[0], 3, 3, padding=1),
        )

    def forward(self, input, t):
        timestep_embed = expand_to_planes(self.timestep_embed(t[:, None]), input.shape)
        v = self.net(torch.cat([input, timestep_embed], dim=1))
        alphas, sigmas = map(partial(append_dims, n=v.ndim), t_to_alpha_sigma(t))
        pred = input * alphas - v * sigmas
        eps = input * sigmas + v * alphas
        return DiffusionOutput(v, pred, eps)
```

2. Diffusion and CLIP model settings

```
#@markdown ####**Models Settings (note: For pixel art, the best is pixelartdiffusion_expanded):**
diffusion_model = "512x512_diffusion_uncond_finetune_008100" #@param ["256x256_diffusion_uncond", "512x512_diffusion_uncond_finetune_008100",

use_secondary_model = True #@param {type: 'boolean'}
diffusion_sampling_mode = 'ddim' #@param ['plms','ddim']
#@markdown ######**Custom model:**
custom_path = '/content/drive/MyDrive/deep_learning/ddpm/ema_0.9999_058000.pt' #@param {type: 'string'}

#@markdown ######**CLIP settings:**
use_checkpoint = True #@param {type: 'boolean'}
ViTB32 = True #@param{type:"boolean"}
ViTB16 = True #@param{type:"boolean"}
ViTL14 = False #@param{type:"boolean"}
ViTL14_336px = False #@param{type:"boolean"}
RN101 = False #@param{type:"boolean"}
RN50 = True #@param{type:"boolean"}
RN50x4 = False #@param{type:"boolean"}
RN50x16 = False #@param{type:"boolean"}
RN50x64 = False #@param{type:"boolean"}

#@markdown ######**OpenCLIP settings:**
ViTB32_laion2b_e16 = False #@param{type:"boolean"}
ViTB32_laion400m_e31 = False #@param{type:"boolean"}
```

Models Settings (note: For pixel art, the best is pixelartdiffusion_expanded):

`diffusion_model:` 512x512_diffusion_uncond_finetune_008100

`use_secondary_model:` ☑

`diffusion_sampling_mode:` ddim

Custom model:

`custom_path:` "/content/drive/MyDrive/deep_learning/ddpm/er"

CLIP settings:

`use_checkpoint:` ☑

`ViTB32:` ☑

`ViTB16:` ☑

```
ViTB32_laion400m_32 = False #@param{type:"boolean"}
ViTB32quickgelu_laion400m_e31 = False #@param{type:"boolean"}
ViTB32quickgelu_laion400m_e32 = False #@param{type:"boolean"}
ViTB16_laion400m_e31 = False #@param{type:"boolean"}
ViTB16_laion400m_e32 = False #@param{type:"boolean"}
RN50_yffcc15m = False #@param{type:"boolean"}
RN50_cc12m = False #@param{type:"boolean"}
RN50_quickgelu_yfcc15m = False #@param{type:"boolean"}
RN50_quickgelu_cc12m = False #@param{type:"boolean"}
RN101_yfcc15m = False #@param{type:"boolean"}
RN101_quickgelu_yfcc15m = False #@param{type:"boolean"}

#@markdown If you're having issues with model downloads, check this to compare SHA's:
check_model_SHA = False #@param{type:"boolean"}

diff_model_map = {
    '256x256_diffusion_uncond': { 'downloaded': False, 'sha': 'a37c32fffd316cd494cf3f35b339936debdc1576dad13fe57c42399a5dbc78b1', 'uri_list':
    '512x512_diffusion_uncond_finetune_008100': { 'downloaded': False, 'sha': '9c111ab89e214862b76e1fa6a1b3f1d329b1a88281885943d2cdbe357ad576
    'portrait_generator_v001': { 'downloaded': False, 'sha': 'b7e8c747af880d4480b6707006f1ace000b058dd0eac5bb13558ba3752d9b5b9', 'uri_list':
    'pixelartdiffusion_expanded': { 'downloaded': False, 'sha': 'a73b40556634034bf43b5a716b531b46fb1ab890634d854f5bcbbef56838739a', 'uri_list
    'pixel_art_diffusion_hard_256': { 'downloaded': False, 'sha': 'be4a9de[illegible]c60ad017723a4d35dc13169c66bb322234161', 'uri_li
    'pixel_art_diffusion_soft_256': { 'downloaded': False, 'sha': 'd321590e46b679bf6def1f1914b47c89e762c76f19ab3e3392c8ca07c791039c', 'uri_li
    'pixelartdiffusion4k': { 'downloaded': False, 'sha': 'a1ba4f13f6dabb72b[illegible]92ad343572cc416deda7cccac30', 'uri_list': ['ht
    'watercolordiffusion_2': { 'downloaded': False, 'sha': '49c281b6092c61c49b0f1f8da93af9b94be7e0c20c71e662e2aa26fee0e4b1a9', 'uri_list': ['
    'watercolordiffusion': { 'downloaded': False, 'sha': 'a3e6522f0c8f278f90788298d66383b11ac763dd5e0d62f8252c962c23950bd6', 'uri_list': ['ht
    'PulpSciFiDiffusion': { 'downloaded': False, 'sha': 'b79e62613b9f50b8a[illegible]efad42a92ec94d014f6e17337f', 'uri_list': ['htt
    'secondary': { 'downloaded': False, 'sha': '983e3de6f95c88c81b2ca7ebb2c217933be1973b1ff058776b970f901584613a', 'uri_list': ['https://hugg
}

kaliyuga_pixel_art_model_names = ['pixelartdiffusion_expanded', 'pixel_art_diffusion_hard_256', 'pixel_art_diffusion_soft_256', 'pixelartdiff
kaliyuga_watercolor_model_names = ['watercolordiffusion', 'watercolordiffusion_2']
kaliyuga_pulpscifi_model_names = ['PulpSciFiDiffusion']
diffusion_models_256x256_list = ['256x256_diffusion_uncond'] + kaliyuga_pixel_art_model_names + kaliyuga_watercolor_model_names + kaliyuga_pu

from urllib.parse import urlparse

def get_model_filename(diffusion_model_name):
    model_uri = diff_model_map[diffusion_model_name]['uri_list'][0]
    model_filename = os.path.basename(urlparse(model_uri).path)
    return model_filename


def download_model(diffusion_model_name, uri_index=0):
    if diffusion_model_name != 'custom':
        model_filename = get_model_filename(diffusion_model_name)
        model_local_path = os.path.join(model_path, model_filename)
        if os.path.exists(model_local_path) and check_model_SHA:
            print(f'Checking {diffusion_model_name} File')
            with open(model_local_path, "rb") as f:
                bytes = f.read()
                hash = hashlib.sha256(bytes).hexdigest()
            if hash == diff_model_map[diffusion_model_name]['sha']:
                print(f'{diffusion_model_name} SHA matches')
                diff_model_map[diffusion_model_name]['downloaded'] = True
            else:
                print(f"{diffusion_model_name} SHA doesn't match. Will redownload it.")
        elif os.path.exists(model_local_path) and not check_model_SHA or diff_model_map[diffusion_model_name]['downloaded']:
            print(f'{diffusion_model_name} already downloaded. If the file is corrupt, enable check_model_SHA.')
            diff_model_map[diffusion_model_name]['downloaded'] = True

        if not diff_model_map[diffusion_model_name]['downloaded']:
            for model_uri in diff_model_map[diffusion_model_name]['uri_list']:
                wget(model_uri, model_path)
                if os.path.exists(model_local_path):
                    diff_model_map[diffusion_model_name]['downloaded'] = True
                    return
                else:
                    print(f'{diffusion_model_name} model download from {model_uri} failed. Will try any fallback uri.')
            print(f'{diffusion_model_name} download failed.')


# Download the diffusion model(s)
download_model(diffusion_model)
if use_secondary_model:
    download_model('secondary')

model_config = model_and_diffusion_defaults()
```

ViTL14: ☐

ViTL14_336px: ☐

RN101: ☐

RN50: ☑

RN50x4: ☐

RN50x16: ☐

RN50x64: ☐

OpenCLIP settings:

ViTB32_laion2b_e16: ☐

ViTB32_laion400m_e31: ☐

ViTB32_laion400m_32: ☐

ViTB32quickgelu_laion400m_e31: ☐

ViTB32quickgelu_laion400m_e32: ☐

ViTB16_laion400m_e31: ☐

ViTB16_laion400m_e32: ☐

RN50_yffcc15m: ☐

RN50_cc12m: ☐

RN50_quickgelu_yfcc15m: ☐

RN50_quickgelu_cc12m: ☐

RN101_yfcc15m: ☐

RN101_quickgelu_yfcc15m: ☐

If you're having issues with model downloads, check this to compare SHA's:

check_model_SHA: ☐

```
if diffusion_model == '512x512_diffusion_uncond_finetune_008100':
    model_config.update({
        'attention_resolutions': '32, 16, 8',
        'class_cond': False,
        'diffusion_steps': 1000, #No need to edit this, it is taken care of later.
        'rescale_timesteps': True,
        'timestep_respacing': 250, #No need to edit this, it is taken care of later.
        'image_size': 512,
        'learn_sigma': True,
        'noise_schedule': 'linear',
        'num_channels': 256,
        'num_head_channels': 64,
        'num_res_blocks': 2,
        'resblock_updown': True,
        'use_checkpoint': use_checkpoint,
        'use_fp16': not useCPU,
        'use_scale_shift_norm': True,
    })
elif diffusion_model == '256x256_diffusion_uncond':
    model_config.update({
        'attention_resolutions': '32, 16, 8',
        'class_cond': False,
        'diffusion_steps': 1000, #No need to edit this, it is taken care of later.
        'rescale_timesteps': True,
        'timestep_respacing': 250, #No need to edit this, it is taken care of later.
        'image_size': 256,
        'learn_sigma': True,
        'noise_schedule': 'linear',
        'num_channels': 256,
        'num_head_channels': 64,
        'num_res_blocks': 2,
        'resblock_updown': True,
        'use_checkpoint': use_checkpoint,
        'use_fp16': not useCPU,
        'use_scale_shift_norm': True,
    })
elif diffusion_model == 'portrait_generator_v001':
    model_config.update({
        'attention_resolutions': '32, 16, 8',
        'class_cond': False,
        'diffusion_steps': 1000,
        'rescale_timesteps': True,
        'image_size': 512,
        'learn_sigma': True,
        'noise_schedule': 'linear',
        'num_channels': 128,
        'num_heads': 4,
        'num_res_blocks': 2,
        'resblock_updown': True,
        'use_checkpoint': use_checkpoint,
        'use_fp16': True,
        'use_scale_shift_norm': True,
    })
else:  # E.g. A model finetuned by KaliYuga
    model_config.update({
          'attention_resolutions': '16',
          'class_cond': False,
          'diffusion_steps': 1000,
          'rescale_timesteps': True,
          'timestep_respacing': 'ddim100',
          'image_size': 256,
          'learn_sigma': True,
          'noise_schedule': 'linear',
          'num_channels': 128,
          'num_heads': 1,
          'num_res_blocks': 2,
          'use_checkpoint': use_checkpoint,
          'use_fp16': True,
          'use_scale_shift_norm': False,
      })

model_default = model_config['image_size']

if use_secondary_model:
    secondary_model = SecondaryDiffusionImageNet2()
    secondary_model.load_state_dict(torch.load(f'{model_path}/secondary_model_imagenet_2.pth', map_location='cpu'))
    secondary_model.eval().requires_grad_(False).to(device)
```

```
clip_models = []
if ViTB32: clip_models.append(clip.load('ViT-B/32', jit=False)[0].eval().requires_grad_(False).to(device))
if ViTB16: clip_models.append(clip.load('ViT-B/16', jit=False)[0].eval().requires_grad_(False).to(device))
if ViTL14: clip_models.append(clip.load('ViT-L/14', jit=False)[0].eval().requires_grad_(False).to(device))
if ViTL14_336px: clip_models.append(clip.load('ViT-L/14@336px', jit=False)[0].eval().requires_grad_(False).to(device))
if RN50: clip_models.append(clip.load('RN50', jit=False)[0].eval().requires_grad_(False).to(device))
if RN50x4: clip_models.append(clip.load('RN50x4', jit=False)[0].eval().requires_grad_(False).to(device))
if RN50x16: clip_models.append(clip.load('RN50x16', jit=False)[0].eval().requires_grad_(False).to(device))
if RN50x64: clip_models.append(clip.load('RN50x64', jit=False)[0].eval().requires_grad_(False).to(device))
if RN101: clip_models.append(clip.load('RN101', jit=False)[0].eval().requires_grad_(False).to(device))
if ViTB32_laion2b_e16: clip_models.append(open_clip.create_model('ViT-B-32', pretrained='laion2b_e16').eval().requires_grad_(False).to(device
if ViTB32_laion400m_e31: clip_models.append(open_clip.create_model('ViT-B-32', pretrained='laion400m_e31').eval().requires_grad_(False).to(de
if ViTB32_laion400m_32: clip_models.append(open_clip.create_model('ViT-B-32', pretrained='laion400m_e32').eval().requires_grad_(False).to(dev
if ViTB32quickgelu_laion400m_e31: clip_models.append(open_clip.create_model('ViT-B-32-quickgelu', pretrained='laion400m_e31').eval().requires
if ViTB32quickgelu_laion400m_e32: clip_models.append(open_clip.create_model('ViT-B-32-quickgelu', pretrained='laion400m_e32').eval().requires
if ViTB16_laion400m_e31: clip_models.append(open_clip.create_model('ViT-B-16', pretrained='laion400m_e31').eval().requires_grad_(False).to(de
if ViTB16_laion400m_e32: clip_models.append(open_clip.create_model('ViT-B-16', pretrained='laion400m_e32').eval().requires_grad_(False).to(de
if RN50_yffcc15m: clip_models.append(open_clip.create_model('RN50', pretrained='yfcc15m').eval().requires_grad_(False).to(device))
if RN50_cc12m: clip_models.append(open_clip.create_model('RN50', pretrained='cc12m').eval().requires_grad_(False).to(device))
if RN50_quickgelu_yfcc15m: clip_models.append(open_clip.create_model('RN50-quickgelu', pretrained='yfcc15m').eval().requires_grad_(False).to(
if RN50_quickgelu_cc12m: clip_models.append(open_clip.create_model('RN50-quickgelu', pretrained='cc12m').eval().requires_grad_(False).to(devi
if RN101_yfcc15m: clip_models.append(open_clip.create_model('RN101', pretrained='yfcc15m').eval().requires_grad_(False).to(device))
if RN101_quickgelu_yfcc15m: clip_models.append(open_clip.create_model('RN101-quickgelu', pretrained='yfcc15m').eval().requires_grad_(False).t

normalize = T.Normalize(mean=[0.48145466, 0.4578275, 0.40821073], std=[0.26862954, 0.26130258, 0.27577711])
lpips_model = lpips.LPIPS(net='vgg').to(device)
```

```
512x512_diffusion_uncond_finetune_008100 already downloaded. If the file is corrupt, enable check_model_SHA.
secondary already downloaded. If the file is corrupt, enable check_model_SHA.
100%|████████████████████████████████████| 338M/338M [00:03<00:00, 116MiB/s]
100%|████████████████████████████████████| 335M/335M [00:02<00:00, 119MiB/s]
100%|████████████████████████████████████| 244M/244M [00:02<00:00, 99.5MiB/s]
Setting up [LPIPS] perceptual loss: trunk [vgg], v[0.1], spatial [off]
Downloading: "https://download.pytorch.org/models/vgg16-397923af.pth" to /root/.cache/torch/hub/checkpoints/vgg16-397923af.pth
100%                                      528M/528M [00:18<00:00, 125MB/s]
Loading model from: /usr/local/lib/python3.8/dist-packages/lpips/weights/v0.1/vgg.pth
```

Custom model settings

Modify in accordance with your training settings and run the cell

```
#@markdown ####**Custom Model Settings:**
if diffusion_model == 'custom':
  model_config.update({
          'attention_resolutions': '16',
          'class_cond': False,
          'diffusion_steps': 1000,
          'rescale_timesteps': True,
          'timestep_respacing': 'ddim100',
          'image_size': 256,
          'learn_sigma': True,
          'noise_schedule': 'linear',
          'num_channels': 128,
          'num_heads': 1,
          'num_res_blocks': 2,
          'use_checkpoint': use_checkpoint,
          'use_fp16': True,
          'use_scale_shift_norm': False,
      })
```

Custom Model Settings:

3. Settings

```
#@markdown ####**Basic Settings:**
batch_name = 'TimeToDisco' #@param{type: 'string'}
steps = 250 #@param [25,50,100,150,250,500,1000]{type: 'raw', allow-input: true}
width_height_for_512x512_models = [1280, 768] #@param{type: 'raw'}
clip_guidance_scale = 5000 #@param{type: 'number'}
tv_scale = 0#@param{type: 'number'}
range_scale = 150#@param{type: 'number'}
sat_scale = 0#@param{type: 'number'}
cutn_batches = 4#@param{type: 'number'}
```

Basic Settings:

batch_name: "TimeToDisco"

steps: 250

width_height_for_512x512_models: [1280, 768]

```
skip_augs = False#@param{type: 'boolean'}

#@markdown ####**Image dimensions to be used for 256x256 models (e.g. pixelart models):**
width_height_for_256x256_models = [512, 448] #@param{type: 'raw'}

#@markdown ####**Video Init Basic Settings:**
video_init_steps = 100 #@param [25,50,100,150,250,500,1000]{type: 'raw', allow-input: true}
video_init_clip_guidance_scale = 1000 #@param{type: 'number'}
video_init_tv_scale = 0.1#@param{type: 'number'}
video_init_range_scale = 150#@param{type: 'number'}
video_init_sat_scale = 300#@param{type: 'number'}
video_init_cutn_batches = 4#@param{type: 'number'}
video_init_skip_steps = 50 #@param{type: 'integer'}

#@markdown ---

#@markdown ####**Init Image Settings:**
init_image = None #@param{type: 'string'}
init_scale = 1000 #@param{type: 'integer'}
skip_steps = 10 #@param{type: 'integer'}
#@markdown *Make sure you set skip_steps to ~50% of your steps if you want to use an init image.*

width_height = width_height_for_256x256_models if diffusion_model in diffusion_models_256x256_list else width_height_for_512x512_mod

#Get corrected sizes
side_x = (width_height[0]//64)*64;
side_y = (width_height[1]//64)*64;
if side_x != width_height[0] or side_y != width_height[1]:
    print(f'Changing output size to {side_x}x{side_y}. Dimensions must by multiples of 64.')

#Make folder for batch
batchFolder = f'{outDirPath}/{batch_name}'
createPath(batchFolder)
```

clip_guidance_scale: 5000

tv_scale: 0

range_scale: 150

sat_scale: 0

cutn_batches: 4

skip_augs: ☐

Image dimensions to be used for 256x256 models (e.g. pixelart models):

width_height_for_256x256_models: [512, 448]

Video Init Basic Settings:

video_init_steps: 100

video_init_clip_guidance_scale: 1000

video_init_tv_scale: 0.1

video_init_range_scale: 150

video_init_sat_scale: 300

video_init_cutn_batches: 4

video_init_skip_steps: 50

Init Image Settings:

init_image: "None"

init_scale: 1000

skip_steps: 10

Make sure you set skip_steps to ~50% of your steps if you want to use an init image.

Animation Settings

[ ] ↳ *4 cells hidden*

Extra Settings

Partial Saves, Advanced Settings, Cutn Scheduling

[ ] ↳ *1 cell hidden*

Prompts

`animation_mode: None` will only use the first set. `animation_mode: 2D / Video` will run through them per the set frames and hold on the last one.

```
# Note: If using a pixelart diffusion model, try adding "#pixelart" to the end of the prompt for a stronger effect. It'll tend to work a lot
text_prompts = {
    0: ["A beautiful painting of a singular lighthouse, shining its light across a tumultuous sea of blood by greg rutkowski and thomas kinka
```

```
    100: ["This set of prompts start at frame 100","This prompt has weight five:5"],
}

image_prompts = {
    # 0:['ImagePromptsWorkButArentVeryGood.png:2',],
}
```

4. Diffuse!

Do the Run!

```
#@title Do the Run!
#@markdown `n_batches` ignored with animation modes.
display_rate = 20 #@param{type: 'number'}
n_batches = 50 #@param{type: 'number'}

if animation_mode == 'Video Input':
    steps = video_init_steps

#Update Model Settings
timestep_respacing = f'ddim{steps}'
diffusion_steps = (1000//steps)*steps if steps < 1000 else steps
model_config.update({
    'timestep_respacing': timestep_respacing,
    'diffusion_steps': diffusion_steps,
})

batch_size = 1

def move_files(start_num, end_num, old_folder, new_folder):
    for i in range(start_num, end_num):
        old_file = old_folder + f'/{batch_name}({batchNum})_{i:04}.png'
        new_file = new_folder + f'/{batch_name}({batchNum})_{i:04}.png'
        os.rename(old_file, new_file)

#@markdown ---


resume_run = False #@param{type: 'boolean'}
run_to_resume = 'latest' #@param{type: 'string'}
resume_from_frame = 'latest' #@param{type: 'string'}
retain_overwritten_frames = False #@param{type: 'boolean'}
if retain_overwritten_frames:
    retainFolder = f'{batchFolder}/retained'
    createPath(retainFolder)


skip_step_ratio = int(frames_skip_steps.rstrip("%")) / 100
calc_frames_skip_steps = math.floor(steps * skip_step_ratio)

if animation_mode == 'Video Input':
    frames = sorted(glob(in_path+'/*.*'));
    if len(frames)==0:
        sys.exit("ERROR: 0 frames found.\nPlease check your video input path and rerun the video settings cell.")
    flows = glob(flo_folder+'/*.*')
    if (len(flows)==0) and video_init_flow_warp:
        sys.exit("ERROR: 0 flow files found.\nPlease rerun the flow generation cell.")

if steps <= calc_frames_skip_steps:
    sys.exit("ERROR: You can't skip more steps than your total steps")

if resume_run:
    if run_to_resume == 'latest':
        try:
            batchNum
        except:
            batchNum = len(glob(f"{batchFolder}/{batch_name}(*)_settings.txt"))-1
    else:
        batchNum = int(run_to_resume)
    if resume_from_frame == 'latest':
        start_frame = len(glob(batchFolder+f"/{batch_name}({batchNum})_*.png"))
        if animation_mode != '3D' and turbo_mode == True and start_frame > turbo_preroll and start_frame % int(turbo_steps) != 0:
            start_frame = start_frame - (start_frame % int(turbo_steps))
    else:
```

`n_batches` ignored with animation modes.

display_rate: 20

n_batches: 50

resume_run: ☐

run_to_resume: " latest "

resume_from_frame: " latest "

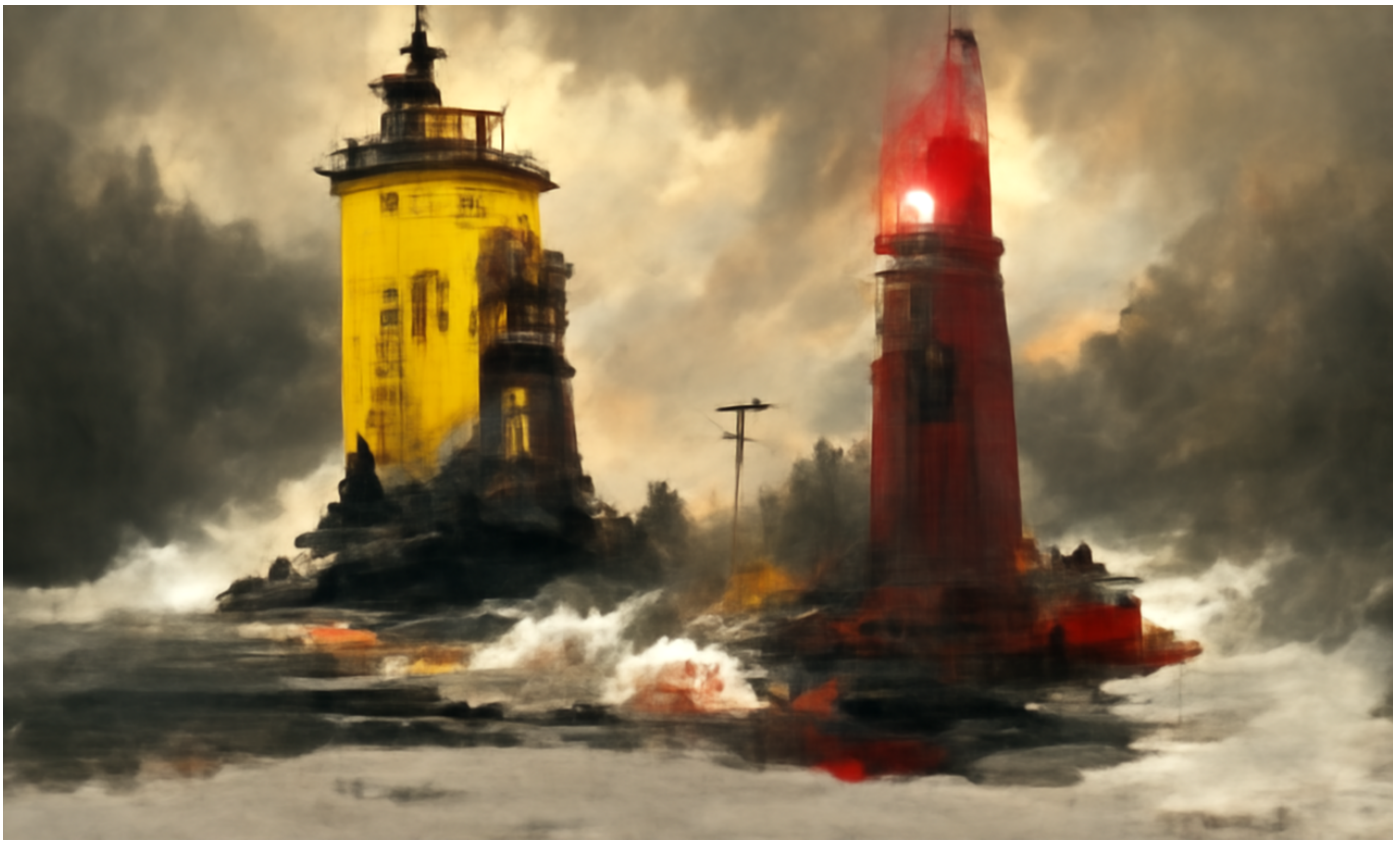
retain_overwritten_frames: ☐

```
        start_frame = int(resume_from_frame)+1
        if animation_mode != '3D' and turbo_mode == True and start_frame > turbo_preroll and start_frame % int(turbo_steps) != 0:
            start_frame = start_frame - (start_frame % int(turbo_steps))
        if retain_overwritten_frames is True:
            existing_frames = len(glob(batchFolder+f"/{batch_name}({batchNum})_*.png"))
            frames_to_save = existing_frames - start_frame
            print(f'Moving {frames_to_save} frames to the Retained folder')
            move_files(start_frame, existing_frames, batchFolder, retainFolder)
else:
    start_frame = 0
    batchNum = len(glob(batchFolder+"/*.txt"))
    while os.path.isfile(f"{batchFolder}/{batch_name}({batchNum})_settings.txt") or os.path.isfile(f"{batchFolder}/{batch_name}-{batchNum}_se
        batchNum += 1

print(f'Starting Run: {batch_name}({batchNum}) at frame {start_frame}')

if set_seed == 'random_seed':
    random.seed()
    seed = random.randint(0, 2**32)
    # print(f'Using seed: {seed}')
else:
    seed = int(set_seed)

args = {
    'batchNum': batchNum,
    'prompts_series':split_prompts(text_prompts) if text_prompts else None,
    'image_prompts_series':split_prompts(image_prompts) if image_prompts else None,
    'seed': seed,
    'display_rate':display_rate,
    'n_batches':n_batches if animation_mode == 'None' else 1,
    'batch_size':batch_size,
    'batch_name': batch_name,
    'steps': steps,
    'diffusion_sampling_mode': diffusion_sampling_mode,
    'width_height': width_height,
    'clip_guidance_scale': clip_guidance_scale,
    'tv_scale': tv_scale,
    'range_scale': range_scale,
    'sat_scale': sat_scale,
    'cutn_batches': cutn_batches,
    'init_image': init_image,
    'init_scale': init_scale,
    'skip_steps': skip_steps,
    'side_x': side_x,
    'side_y': side_y,
    'timestep_respacing': timestep_respacing,
    'diffusion_steps': diffusion_steps,
    'animation_mode': animation_mode,
    'video_init_path': video_init_path,
    'extract_nth_frame': extract_nth_frame,
    'video_init_seed_continuity': video_init_seed_continuity,
    'key_frames': key_frames,
    'max_frames': max_frames if animation_mode != "None" else 1,
    'interp_spline': interp_spline,
    'start_frame': start_frame,
    'angle': angle,
    'zoom': zoom,
    'translation_x': translation_x,
    'translation_y': translation_y,
    'translation_z': translation_z,
    'rotation_3d_x': rotation_3d_x,
    'rotation_3d_y': rotation_3d_y,
    'rotation_3d_z': rotation_3d_z,
    'midas_depth_model': midas_depth_model,
    'midas_weight': midas_weight,
    'near_plane': near_plane,
    'far_plane': far_plane,
    'fov': fov,
    'padding_mode': padding_mode,
    'sampling_mode': sampling_mode,
    'angle_series':angle_series,
    'zoom_series':zoom_series,
    'translation_x_series':translation_x_series,
    'translation_y_series':translation_y_series,
    'translation_z_series':translation_z_series,
    'rotation_3d_x_series':rotation_3d_x_series,
    'rotation_3d_y_series':rotation_3d_y_series,
```

```
    'rotation_3d_z_series':rotation_3d_z_series,
    'frames_scale': frames_scale,
    'skip_step_ratio': skip_step_ratio,
    'calc_frames_skip_steps': calc_frames_skip_steps,
    'text_prompts': text_prompts,
    'image_prompts': image_prompts,
    'cut_overview': eval(cut_overview),
    'cut_innercut': eval(cut_innercut),
    'cut_ic_pow': eval(cut_ic_pow),
    'cut_icgray_p': eval(cut_icgray_p),
    'intermediate_saves': intermediate_saves,
    'intermediates_in_subfolder': intermediates_in_subfolder,
    'steps_per_checkpoint': steps_per_checkpoint,
    'perlin_init': perlin_init,
    'perlin_mode': perlin_mode,
    'set_seed': set_seed,
    'eta': eta,
    'clamp_grad': clamp_grad,
    'clamp_max': clamp_max,
    'skip_augs': skip_augs,
    'randomize_class': randomize_class,
    'clip_denoised': clip_denoised,
    'fuzzy_prompt': fuzzy_prompt,
    'rand_mag': rand_mag,
    'turbo_mode':turbo_mode,
    'turbo_steps':turbo_steps,
    'turbo_preroll':turbo_preroll,
    'use_vertical_symmetry': use_vertical_symmetry,
    'use_horizontal_symmetry': use_horizontal_symmetry,
    'transformation_percent': transformation_percent,
    #video init settings
    'video_init_steps': video_init_steps,
    'video_init_clip_guidance_scale': video_init_clip_guidance_scale,
    'video_init_tv_scale': video_init_tv_scale,
    'video_init_range_scale': video_init_range_scale,
    'video_init_sat_scale': video_init_sat_scale,
    'video_init_cutn_batches': video_init_cutn_batches,
    'video_init_skip_steps': video_init_skip_steps,
    'video_init_frames_scale': video_init_frames_scale,
    'video_init_frames_skip_steps': video_init_frames_skip_steps,
    #warp settings
    'video_init_flow_warp':video_init_flow_warp,
    'video_init_flow_blend':video_init_flow_blend,
    'video_init_check_consistency':video_init_check_consistency,
    'video_init_blend_mode':video_init_blend_mode
}

if animation_mode == 'Video Input':
    # This isn't great in terms of what will get saved to the settings.. but it should work.
    args['steps'] = args['video_init_steps']
    args['clip_guidance_scale'] = args['video_init_clip_guidance_scale']
    args['tv_scale'] = args['video_init_tv_scale']
    args['range_scale'] = args['video_init_range_scale']
    args['sat_scale'] = args['video_init_sat_scale']
    args['cutn_batches'] = args['video_init_cutn_batches']
    args['skip_steps'] = args['video_init_skip_steps']
    args['frames_scale'] = args['video_init_frames_scale']
    args['frames_skip_steps'] = args['video_init_frames_skip_steps']

args = SimpleNamespace(**args)

print('Prepping model...')
model, diffusion = create_model_and_diffusion(**model_config)
if diffusion_model == 'custom':
    model.load_state_dict(torch.load(custom_path, map_location='cpu'))
else:
    model.load_state_dict(torch.load(f'{model_path}/{get_model_filename(diffusion_model)}', map_location='cpu'))
model.requires_grad_(False).eval().to(device)
for name, param in model.named_parameters():
    if 'qkv' in name or 'norm' in name or 'proj' in name:
        param.requires_grad_()
if model_config['use_fp16']:
    model.convert_to_fp16()

gc.collect()
torch.cuda.empty_cache()
try:
```

```
    do_run()
except KeyboardInterrupt:
    pass
finally:
    print('Seed used:', seed)
    gc.collect()
    torch.cuda.empty_cache()
```

Batches: 0% 0/50 [08:06<?, ?it/s]



Steps: 53% 128/240 [08:06<07:22, 3.95s/it]

```
Seed used: 1333734556
```

```
!pip install flask-ngrok
```

```
from flask import Flask
from flask_ngrok import run_with_ngrok
app = Flask(__name__)
run_with_ngrok(app)

@app.route("/")
def home():
    return "<h1>GFG is great platform to learn</h1>"

app.run()
```

```
 * Serving Flask app "__main__" (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production deployment.
   Use a production WSGI server instead.
 * Debug mode: off
INFO:werkzeug: * Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
 * Running on http://d1ac-34-142-138-59.ngrok.io
 * Traffic stats available on http://127.0.0.1:4040
INFO:werkzeug:127.0.0.1 - - [24/Jan/2023 12:03:22] "GET / HTTP/1.1" 200 -
INFO:werkzeug:127.0.0.1 - - [24/Jan/2023 12:03:23] "GET /favicon.ico HTTP/1.1" 404 -
```

```
apiKey = "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"; http://d1ac-34-142-138-59.ngrok.io; http://127.0.0.1:5000/ ;
```

Colab paid products - Cancel contracts here

✓ 5m 26s completed at 3:40 AM