Colorization

Deep Learning Project

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Contents

1. 중간발표 Review

Colorization

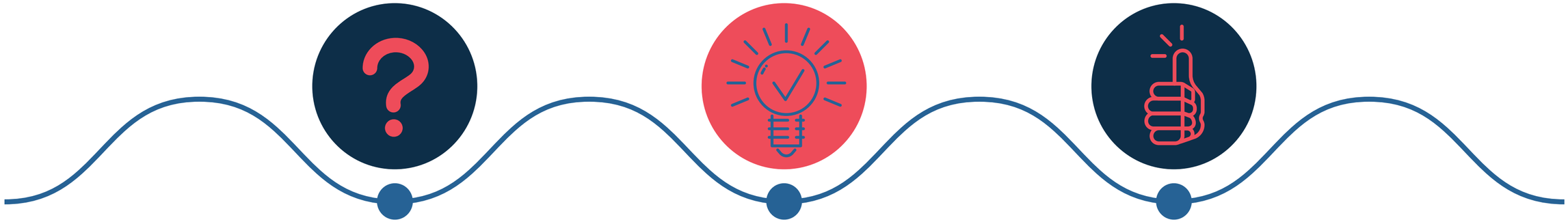
흑백 사진을 칼라 사진으로 Deep Learning을 통해 바꾸는 방법론
단색 사진이나 비디오에 컬러 정보를 추가하는 과정
고유한 솔루션이 없는 3차원 색의 값, 밝기를 이미지와 매핑해야 함

예시

출처: https://arxiv.org/abs/2108.08826

1. 중간발표 Review

주제 선택



단점

Train data와 유사한 image의 Colorization만 잘 이뤄진다는 단점이 존재

Think

특정 데이터셋에 맞게 변형을 해보면 어떨까?

Result

한국과 관련된 이미지 데이터 셋을 활용해서 Colorization을 진행

한국의 이미지 데이터셋에 Colorization 적용

2. Dataset 소개

AI Hub

- 한국 이미지(음식)

출처: https://www.aihub.or.kr/aihubdata/data/view.do?currMenu=115&topMenu=100&dataSetSn=79

구축 수량 : 150종 X 1,000장

2. Dataset 소개

Data Resize

```
for zip_name in file_list[0:]:
    print(zip_name)
    folder_name = zip_name.split('.')[0]
    f_name = zip_name.split('.')[0]

    with ZipFile(data_path+f'{zip_name}', 'r') as zipObj:
        listOfFileNames = [file for file in zipObj.namelist() if file.endswith(".jpg") or file.endswith(".JPG")]

        fol_lst = []
        for i in listOfFileNames:
            fol_lst.append(i.split('/')[1])
        # 폴더 생성
        for i in fol_lst:
            createDirectory('/content/drive/MyDrive/딥러닝/DATASET/'+f'음식/color_image')
            createDirectory('/content/drive/MyDrive/딥러닝/DATASET/'+f'음식/gray_image')

        for img_num in tqdm(range(0,len(listOfFileNames))):
            image_name = listOfFileNames[img_num].split('.')[0] # 경로 포함한 이미지 이름
            img_real_name = listOfFileNames[img_num].split('/')[-1].split('.')[0] # 이미지 자체의 이름

            name = listOfFileNames[img_num]
            readed = zipObj.open(name) # binary 형태로 읽기

            src=Image.open(readed)
            src = np.array(src)

            src_re=cv2.resize(src, (224,224))

            # 이미지 저장하기
            src_re = Image.fromarray(src_re) # NumPy array to PIL image
            src_re.save('/content/drive/MyDrive/딥러닝/DATASET/'+f"음식/color_image/"+f'{f_name}_{img_real_name}_color.png')
            # 이미지 저장하기
            src_gray = src_re.convert('L') # 흑백 변환
            src_gray.save('/content/drive/MyDrive/딥러닝/DATASET/'+f"음식/gray_image/"+f'{f_name}_{img_real_name}_gray.png')
```

- 종류
  회, 해물, 한과, 튀김, 탕, 찌개, 죽, 찜,
  전골, 조림, 적, 장아찌, 전, 음청류, 장,
  쌈, 밥, 볶음, 무침, 만두, 떡, 나물, 면,
  기타, 김치, 국, 구이 등 …

- 224X224로 resize

- color와 gray 한쌍으로 구성

- train : test = 12,922:2,465 으로 구성

3. 실험 방식

1. 선택한 3가지 모델에 한국 전통 이미지에 적용했을 때 잘 작동되는지 확인해보기

2. 데이터셋(한국 관련 이미지)으로 3가지 모델들을 fine-tuning

3. 그 중 어느 모델이 더 나은지 실험, 비교해보기

선택한 모델 : ChromaGAN, DeOldify, InstColor

4. 모델링

GitHub

Google Colab

4. 모델링

ChromaGAN

Paper : ChromaGAN: Adversarial Picture Colorization with Semantic Class Distribution

```python
class Colorization(nn.Module):
    """
    The Colorization model that takes an input image and outputs a colorized image.
    The model is based on the VGG16 network.
    :param: input_image: input image
    :param: output_image: output image
    """

    def __init__(self, input_size=224):
        super().__init__()
        # raise error if input size is not 224
        if input_size != 224:
            raise ValueError("Input size must be 224")

        # Load VGG16 model pretrained on ImageNet dataset
        vgg = models.vgg16(pretrained=True)

        #  Freeze all the parameters of the VGG16 model
        self.vgg = nn.Sequential(*list(vgg.features.children())[:-8])

        # Global Features
        self.global_features_1 = ConvBlock(512, 512, 3, 2, 1)
        self.global_features_2 = ConvBlock(512, 512, 3, 1, 1)
        self.global_features_3 = ConvBlock(512, 512, 3, 2, 1)
        self.global_features_4 = ConvBlock(512, 512, 3, 1, 1)

        # Dense layers
        self.flatten = nn.Flatten()

        self.fully_connected_1 = nn.Sequential(
            nn.Linear(512 * 7 * 7, 1024),
            nn.Linear(1024, 512),
            nn.Linear(512, 256),
        )
```

```python
        self.fully_connected_2 = nn.Sequential(
            nn.Linear(512 * 7 * 7, 4096),
            nn.Linear(4096, 4096),
            nn.Linear(4096, 1000),
            nn.Softmax()
        )

        # Mid-level Features
        self.mid_level_features_1 = ConvBlock(512, 512, 3, 1, 1)
        self.mid_level_features_2 = ConvBlock(512, 256, 3, 1, 1)

        # Output layers
        self.output_1 = SimpleConvBlock(512, 256, 1, 1, 0)
        self.output_2 = SimpleConvBlock(256, 128, 3, 1, 1)
        self.output_3 = SimpleConvBlock(128, 64, 3, 1, 1)
        self.output_4 = SimpleConvBlock(64, 64, 3, 1, 1)
        self.output_5 = SimpleConvBlock(64, 32, 3, 1, 1)
        self.output_6 = nn.Sequential(
            nn.Conv2d(32, 2, 3, 1, 1),
            nn.Sigmoid()
        )

        self.up_sample = nn.Upsample(scale_factor=2)
```

224 × 224 pixels를 VGG-16에서 학습

4. 모델링

ChromaGAN

Paper : ChromaGAN: Adversarial Picture Colorization with Semantic Class Distribution

config.py × 리소스

```python
import torch

GRADIENT_PENALTY_WEIGHT = 10

EPOCHS = 10
MODEL_DIR = 'models'
MODEL_C = MODEL_DIR + '/colorization_10.pt'
MODEL_D = MODEL_DIR + '/discriminator_10.pt'

TRAIN_PATH = '../DATASET/train/color_image'
TEST_PATH = '../DATASET/test/color_image'

TR_PATH = 'train/'
TE_PATH = 'test/'

OUTPUT_PATH = 'Output_10/'+TR_PATH

BATCH_SIZE = 1
TEST_BATCH_SIZE = 1

# -1 for no log
CHECK_PER = 100

LR = 2e-5
DEVICE = "cuda" if torch.cuda.is_available() else "cpu"

```

GitHub 코드 이용

orignal code :
https://github.com/pvitoria/ChromaGAN

pytorch version remake :
https://github.com/superhighlevel/ChromaGan_Pytorch_Remake

4. 모델링

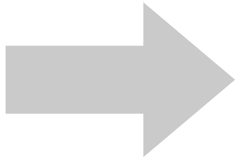
ChromaGAN

Paper : ChromaGAN: Adversarial Picture Colorization with Semantic Class Distribution

```
LOSS_G = MODEL_DIR + '/Loss_G.pkl'
LOSS_D = MODEL_DIR + '/Loss_D.pkl'
```

```
#Loss_G[epoch] = l_g
#Loss_D[epoch] = l_d

#with open(config.LOSS_G,'wb') as f:
#    pickle.dump(Loss_G,f)
#with open(config.LOSS_D,'wb') as f:
#    pickle.dump(Loss_D,f)
```



```
EPOCH 0 / 10
------------------------------
  0% 0/12922 [00:00<?, ?it/s]

Epoch 0 - Batch 0 - Loss G: -0,046164851635694504 - Loss D: 6,5293869972229
  8% 1000/12922 [06:20<23:35,  8,42it/s]

Epoch 0 - Batch 1000 - Loss G: -0,04567399621009827 - Loss D: 7,085413455963135
 15% 2000/12922 [08:20<21:43,  8,38it/s]

Epoch 0 - Batch 2000 - Loss G: -0,04809000343084335 - Loss D: 3,0626063346862793
 23% 3000/12922 [10:19<19:26,  8,51it/s]

Epoch 0 - Batch 3000 - Loss G: -0,049879949539899826 - Loss D: 9,374524116516113
 31% 4000/12922 [12:19<17:43,  8,39it/s]

Epoch 0 - Batch 4000 - Loss G: -0,04450934752821922 - Loss D: 0,6630321741104126
 39% 5000/12922 [14:18<15:37,  8,45it/s]

Epoch 0 - Batch 5000 - Loss G: -0,046820785850286484 - Loss D: 1376,5238037109375
 46% 6000/12922 [16:17<13:45,  8,39it/s]

Epoch 0 - Batch 6000 - Loss G: -0,046261802315711975 - Loss D: 16,247177124023438
 54% 7000/12922 [18:18<11:42,  8,43it/s]

Epoch 0 - Batch 7000 - Loss G: -0,05131150782108307 - Loss D: 69,78662872314453
 62% 8000/12922 [20:17<09:45,  8,41it/s]
```

Loss 값 저장해서 확인해보려고 코드를 추가했지만
out of memory로 제대로 진행이 안됨
=> print되는 것으로 loss 확인

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out of memory로 인해
epoch 수를 줄이는 등 시도를 해본 뒤, 데이터 양을 줄이기로 하고
train : test = 12,922 : 2,465로 확정

Colab Pro

python version = 3.7

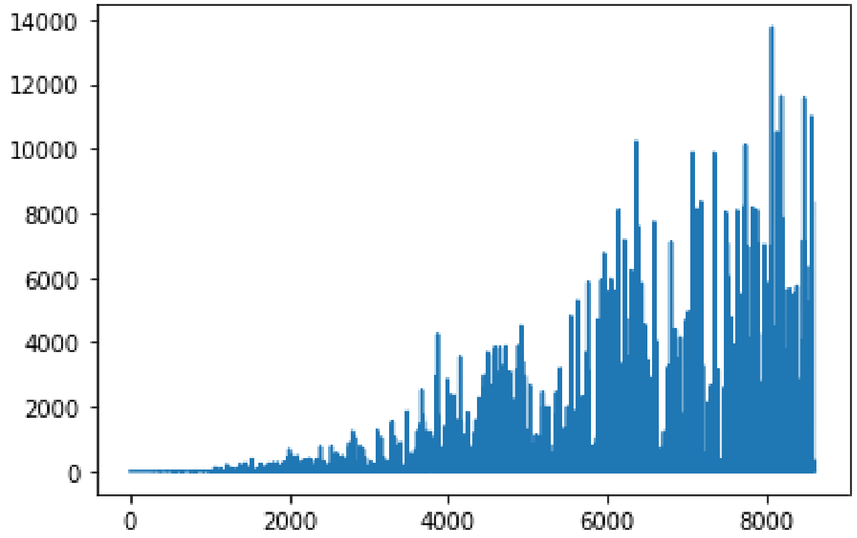
epochs = 10
learning_rate = 2e-5

4. 모델링

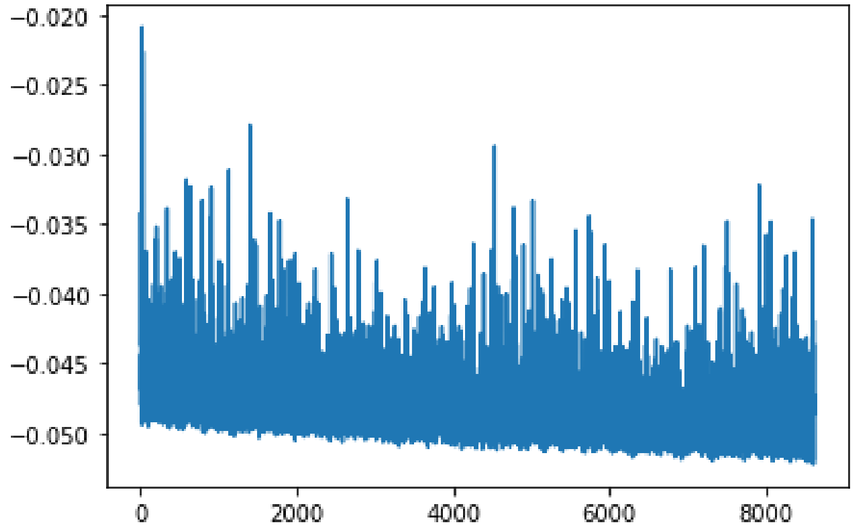
ChromaGAN

Paper : ChromaGAN: Adversarial Picture Colorization with Semantic Class Distribution

Discriminator Loss 일부



Generator Loss 일부



4. 모델링

DeOldify

GitHub 코드 이용

code :
https://github.com/jantic/DeOldify

학습 진행 실패

pre-train된 모델에 넣은 결과물 일부







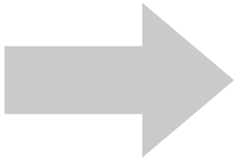
4. 모델링

InstColor

Paper : Instance-aware Image Colorization, CVPR 2020

GitHub 코드 이용

code :
https://github.com/ericsujw/InstColorization



학습 진행 실패

추가 참조 :
https://github.com/dayoungMM/Deepcolorization

4. 모델링

InstColor

Paper : Instance-aware Image Colorization, CVPR 2020

Fine-training 실패이유 : 원작자의 Pre-train-weight가 있는 URL이 삭제됨(원작자 URL업데이트 X)
해결 방안 : 삭제된 checkpoints 파일을 구글링하여 찾은 후 URL을 수정 후 다운받아서 사용
해결 방안 실패 이유 : checkpoints의 Pre-training된 Weight들이 일부밖에 없었음 완전한 파일 존재 X

download_model.sh download.py

```python
#taken from this StackOverflow answer: https://stackoverflow.com/a/39225039
import requests
from os.path import join, isdir
import os
from argparse import ArgumentParser

def download_file_from_google_drive(id, destination):
    URL = "https://docs.google.com/uc?export=download"

    session = requests.Session()

    response = session.get(URL, params = { 'id' : id }, stream = True)
    token = get_confirm_token(response)

    if token:
        params = { 'id' : id, 'confirm' : token }
        response = session.get(URL, params = params, stream = True)

    save_response_content(response, destination)

def get_confirm_token(response):
    for key, value in response.cookies.items():
        if key.startswith('download_warning'):
            return value
```

```
!sh scripts/train.sh

cp: cannot stat './checkpoints/siggraph_retrained/latest_net_G.pth': No such file or directory
#training images = 15
initialize network with normal
model [TrainModel] was created
Setting up a new session...
Exception in user code:
------------------------------------------------------------
Traceback (most recent call last):
  File "/usr/local/lib/python3.8/dist-packages/urllib3/connection.py", line 158, in _new_conn
    conn = connection.create_connection(
  File "/usr/local/lib/python3.8/dist-packages/urllib3/util/connection.py", line 80, in create_connection
    raise err
  File "/usr/local/lib/python3.8/dist-packages/urllib3/util/connection.py", line 70, in create_connection
    sock.connect(sa)
ConnectionRefusedError: [Errno 111] Connection refused
```

```
!sh scripts/train.sh

WARNING: timestamping does nothing in combination with -O. See the manual
for details.

--2022-12-11 11:28:31--  http://colorization.eecs.berkeley.edu/siggraph/models/pytorch.pth
Resolving colorization.eecs.berkeley.edu (colorization.eecs.berkeley.edu)... 128.32.244.190
Connecting to colorization.eecs.berkeley.edu (colorization.eecs.berkeley.edu)|128.32.244.190|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 136785828 (130M)
Saving to:  './checkpoints/siggraph_retrained/latest_net_G.pth'

./checkpoints/siggr 100%[===================>] 130.45M  11.3MB/s    in 36s

2022-12-11 11:29:07 (3.67 MB/s) -  './checkpoints/siggraph_retrained/latest_net_G.pth'  saved [136785828/136785828]

mkdir: cannot create directory  './checkpoints/coco_full' : File exists
#training images = 15
initialize network with normal
model [TrainModel] was created
loading the model from ./checkpoints/coco_full/latest_net_G.pth
Setting up a new session...
Exception in user code:
------------------------------------------------------------
Traceback (most recent call last):
  File "/usr/local/lib/python3.8/dist-packages/urllib3/connection.py", line 158, in _new_conn
    conn = connection.create_connection(
  File "/usr/local/lib/python3.8/dist-packages/urllib3/util/connection.py", line 80, in create_connection
    raise err
  File "/usr/local/lib/python3.8/dist-packages/urllib3/util/connection.py", line 70, in create_connection
    sock.connect(sa)
ConnectionRefusedError: [Errno 111] Connection refused

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "/usr/local/lib/python3.8/dist-packages/urllib3/connectionpool.py", line 597, in urlopen
    httplib_response = self._make_request(conn, method, url,
```

5. 평가 지표

PSNR(Peak Signal-to-Nosie Ratio)

: 실제 이미지와 생성된 이미지 간의 손실 정도를 판단하기 위한 평가 지표

```python
from math import log10, sqrt
import cv2
import numpy as np

def PSNR(original, compressed):
    mse = np.mean((original - compressed) ** 2)
    if(mse == 0):  # MSE is zero means no noise is present in the signal .
                   # Therefore PSNR have no importance.
        return 100
    max_pixel = 255.0
    psnr = 20 * log10(max_pixel / sqrt(mse))
    return psnr

def main():
     original = cv2.imread("original_image.png")
     compressed = cv2.imread("compressed_image.png", 1)
     value = PSNR(original, compressed)
     print(f"PSNR value is {value} dB")

if __name__ == "__main__":
    main()
```

SSIM(Structural Similarity Index Measure)

: 두 이미지 간의 유사성을 측정하는데 사용되는 metric

```python
from IQA_pytorch import SSIM, utils
from PIL import Image
import torch

device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')

ref_path  = 'r0.png'
dist_path = 'r1.png'

ref = utils.prepare_image(Image.open(ref_path).convert("RGB")).to(device)
dist = utils.prepare_image(Image.open(dist_path).convert("RGB")).to(device)

model = SSIM(channels=3)

score = model(dist, ref, as_loss=False)
print('score: %.4f' % score.item())
```

5. 평가 지표

ChromaGAN

trian data 약 1만3천 장10epoch 학습 결과

기존 weight

10epoch 학습

원본 컬러 이미지

5. 평가 지표

ChromaGAN

기존 약 2만5천장의 사진으로 3epcoh 학습 진행

흑백 이미지

기존 weight

한국 음식 이미지로 fine-tuning

원본 컬러 이미지

감사합니다!