Neural Style Transfer:

Bridging Content and Style for Enhanced Visual Creativity

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Introduction

What is Neural Style Transfer (NST)?

- What is Deep Learning?

- What is Convolutional Neural Network (CNN)?

- What is VGG Network?

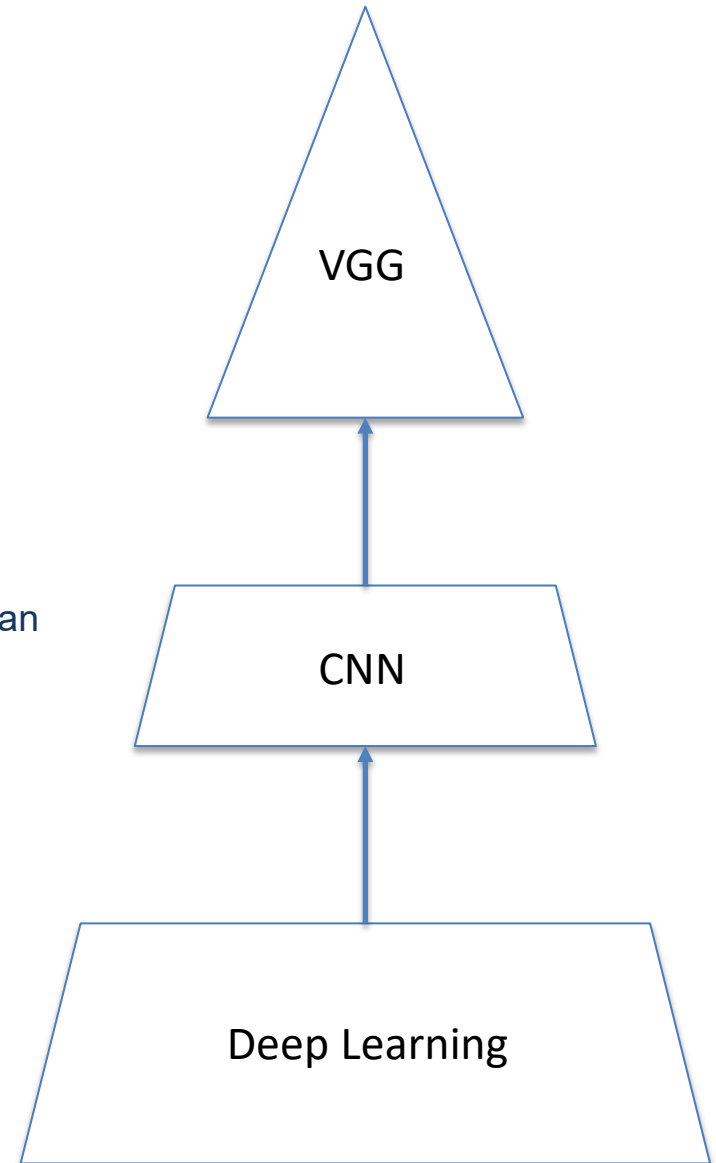# Introduction

- **Deep Learning**

—— Simulate the learning pattern of the human brain through deep neural networks and automatically extract features from large amounts of data.

- **Convolutional Neural Network (CNN)**

—— A deep learning model specifically designed for image processing that automatically extracts hierarchical features of an image, from low to high levels (e.g. edges to complex shapes) through convolutional layers.

- **VGG Network**

——VGG network model is a specific CNN architecture. It extracts multiple layers of image features through multiple continuous convolution layers.
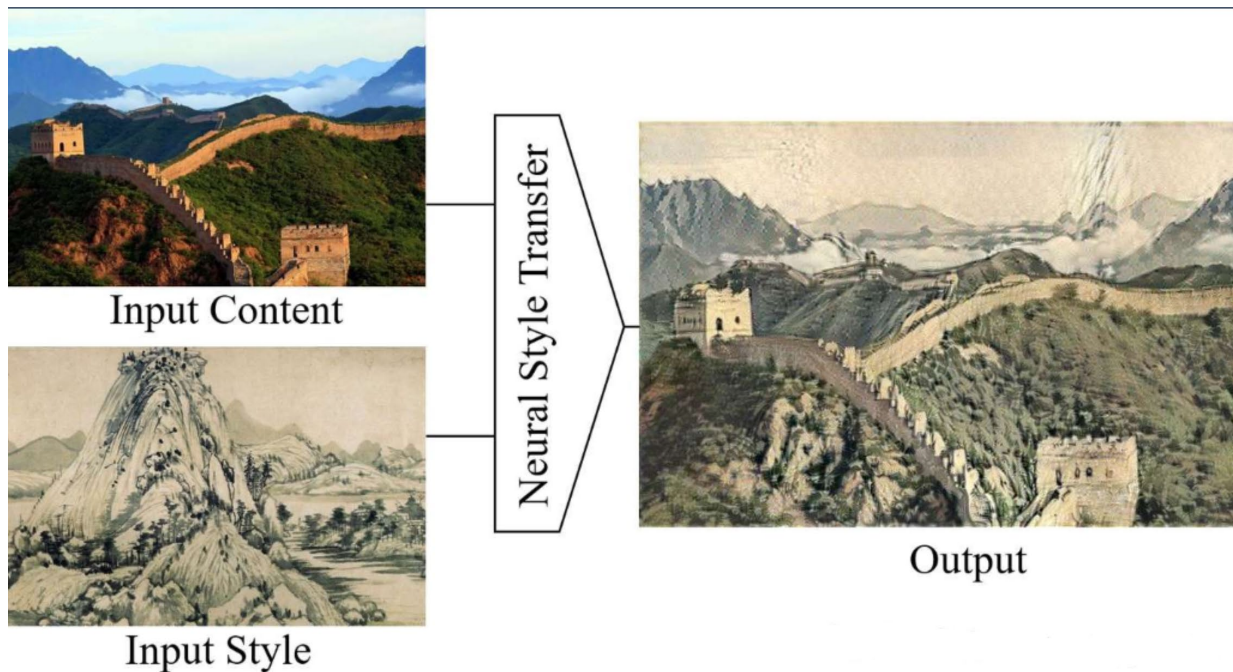
Introduction

What is Neural Style Transfer (NST)?

- It also named Painting Style Migration for convolutional neural networks[3]

- A deep learning algorithms that can withdraw some characteristic from one picture and put its style on another picture[3]

Introduction

How does the NST work?

Content Image + Style Image → Generate→ Combination Output
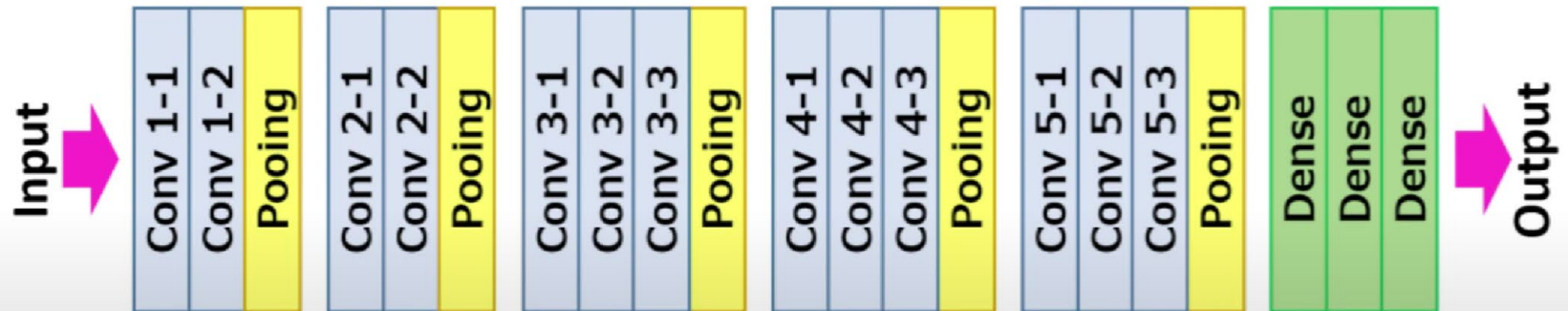
Introduction

How does the NST work?

Generating of style and content images by

Convolutional Neural Networks - Normally use VGG16/19

VGG Neural Network

Introduction

How does the NST work?

Loss

—— Content Loss:

Make sure that the high-level features of the generated image are similar to the content image.

—— Style Loss:

Make sure that the low-level features of the generated image match the style image.
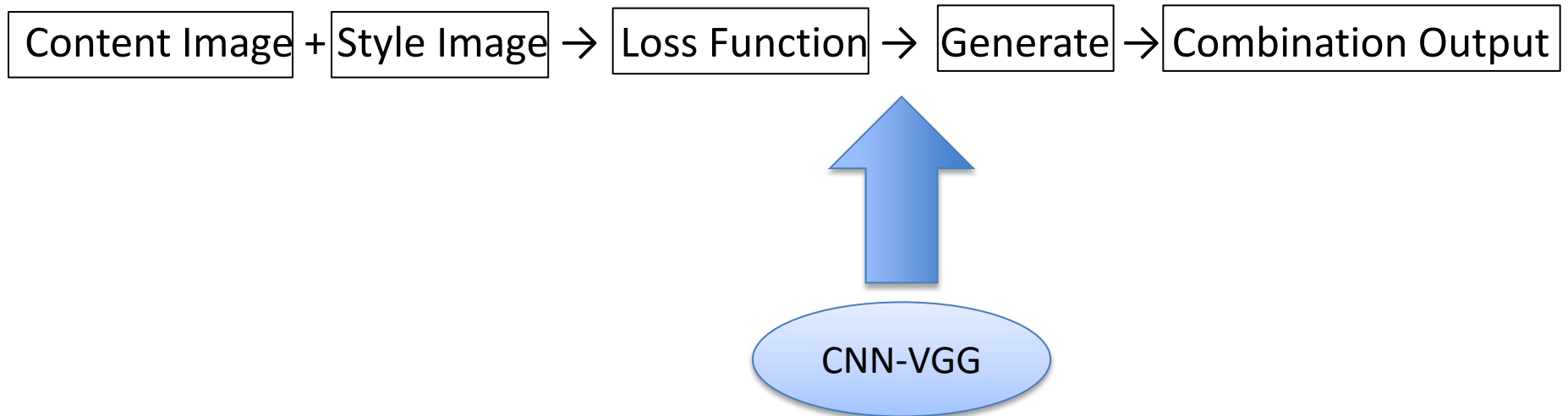
$$\mathcal{L}_{\text{total}}(G) = \alpha \mathcal{L}_{\text{content}}(C, G) + \beta \mathcal{L}_{\text{style}}(S, G)$$

Introduction

How does the NST work?

Optimization of the generated image:

By constantly adjusting the pixels of the generated image to minimize the loss of content and style then optimize its balance, the final output image is obtained.

Content Image + Style Image → Loss Function → Generate → Combination Output

CNN-VGG

About the application of the NST

- Turn photos in artistic style

How to turn
photos into art in
one tap?

Try Prisma →

About the application of the NST

- The Prisma App
- DeepArt.io
- Google DeepDream
- Stable Diffusion
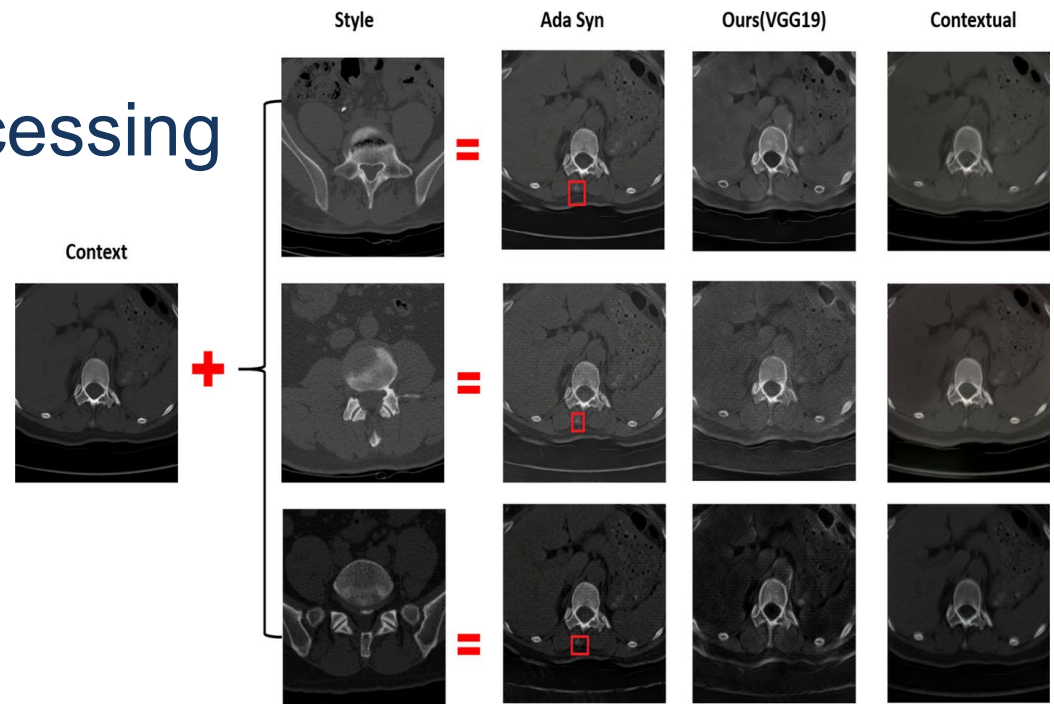
About the application of the NST

- Designing and Advertising

  Fashion so as to personalize and synthesize
  new custom clothes based on a users preference

Neural Style Transfer

Stylized Garments

About the application of the NST

- Processing every frame in the video[5]

- Help people have a more creative mind

- Medical image processing

Motivation

Why choose this question？

- How could that process

  image in Van Gogh Style?

Motivation

Why choose this question？

- The movie "Midnight in Paris"

Inspired me

- The style transfer are in the

Junction of the art and technique

Make ereryone paint like an artist

Related Work

What will be done for other researchers in the past?

- **2015:** Gatys et al. first proposed a deep learning-based neural style migration algorithm in their paper "A Neural Algorithm of Artistic Style", laying the foundation for this field[1]

First time using deep learning for art painting style learning. "Giving" famous painting styles to ordinary photos
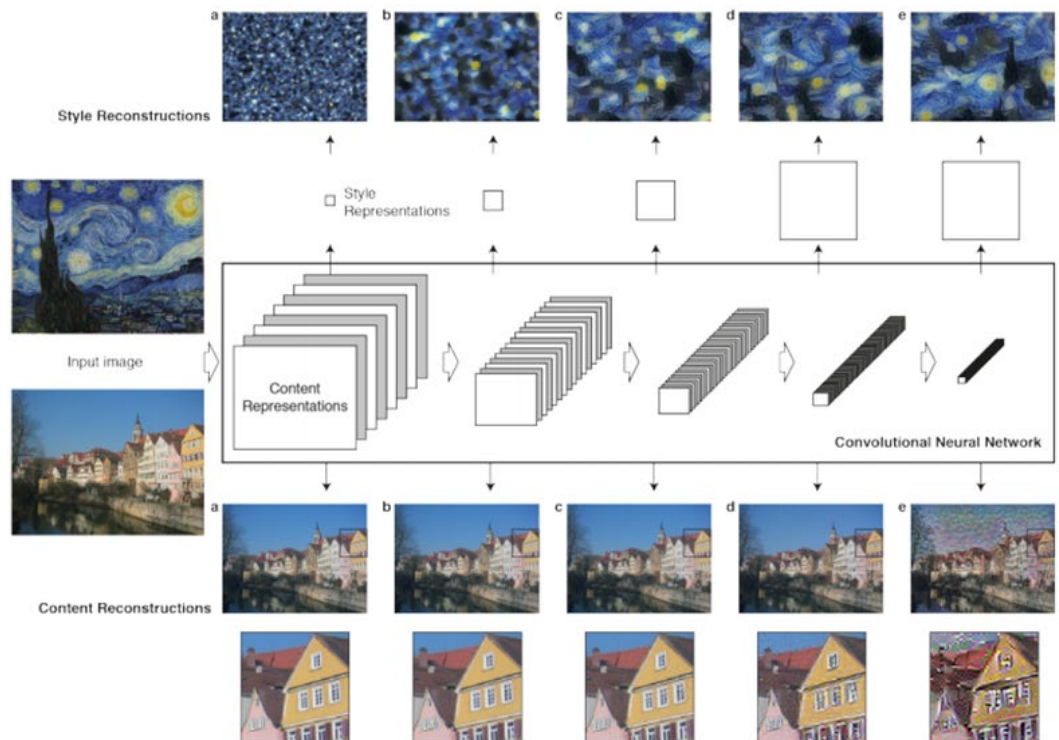
2015
Gatys

Related Work

What will be done for other researchers in the past?

- **2016**: Johnson et al. proposed a near real-time style migration method in their paper "Perceptual Losses for Real-Time Style Transfer and Super-Resolution", dramatically increasing processing speed and enabling real-time application on mobile devices.[8]

$$L\left(\text{perceptual loss}\right) = \left|\text{features of the generated image} - \text{features of the real image}\right|$$

2015 Gatys	2016 Johnson

Related Work

What will be done for other researchers in the past?

- **2018**: Researchers proposed multiple efficient style migration algorithms, such as using Fast Neural Style Transfer (FNST) to reduce computation time, further promoting the practicalization of the technology.[9]

2015 Gatys	2016 Johnson	2018 Connor Shorten

Related Work

What will be done for other researchers in the past?

- **2021**: Recent research proposed a text-guided style migration method without optimization, encoding content images and stylized text cues to extract features and generate new images, further improving the efficiency and flexibility of the technology.[10]

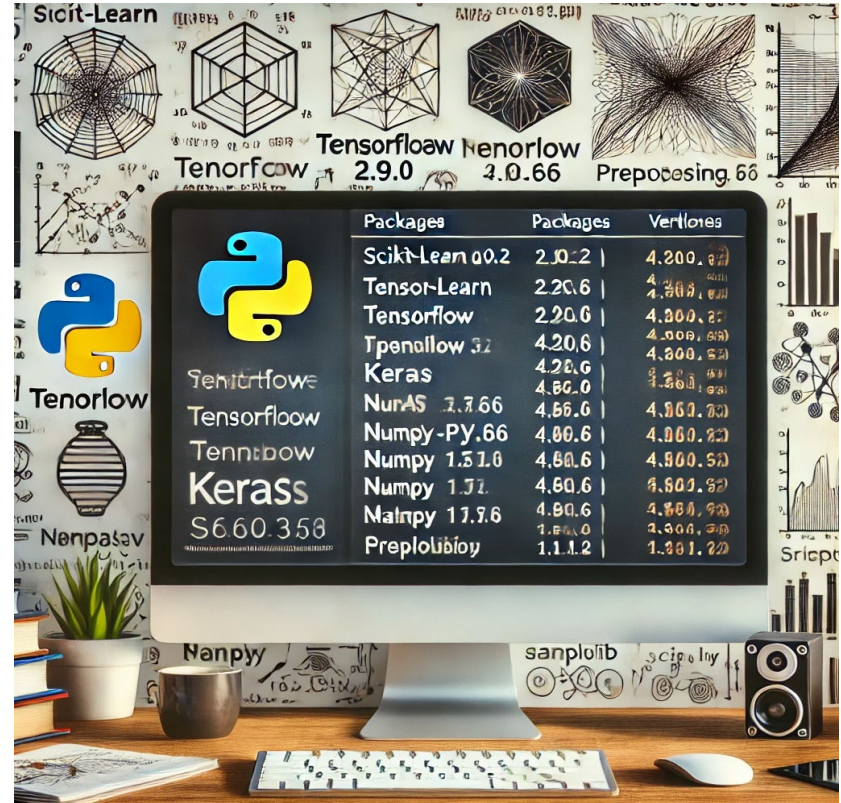| 2015 Gatys	2016 Johnson	2018 Connor Shorten	2021 Ren togo

Methodology

Environment:

scikit-learn 1.0.2、tensorflow 2.9.1

keras 2.9.0、opencv-python 4.6.0.

numpy 1.21.6、pandas 1.4.3

matplotlib 3.5.2、scipy 1.8.1

keras-preprocessing 1.1.2

Methodology

(1)Model Architecture

Convolutional Neural Networks

VGG19

(2) Loss Functions

Ltotal=Lcontent+Lstyle

(3)Training process

(4)Evaluation

evaluated visually

fidelity of the generated images

To the original content.

```python
#Content model define
def vgg_avg_pooling(shape):
    vgg = VGG16(input_shape=shape,weights='imagenet',include_top=False)
    model = Sequential()
    for layer in vgg.layers:
        if layer.__class__ == MaxPooling2D:
        # replace it with average pooling
            model.add(AveragePooling2D())
        else:
            model.add(layer)
    return model


def vgg_cutoff(shape,num_conv):
    if num_conv<1|num_conv>13:
        print('Error layer must be with in [1,13]')
    model = vgg_avg_pooling(shape)
    new_model = Sequential()
    n=0
    for layer in model.layers:
        new_model.add(layer)
        if layer.__class__ == Conv2D:
            n+=1
        if n >= num_conv:
            break
    return new_model
```
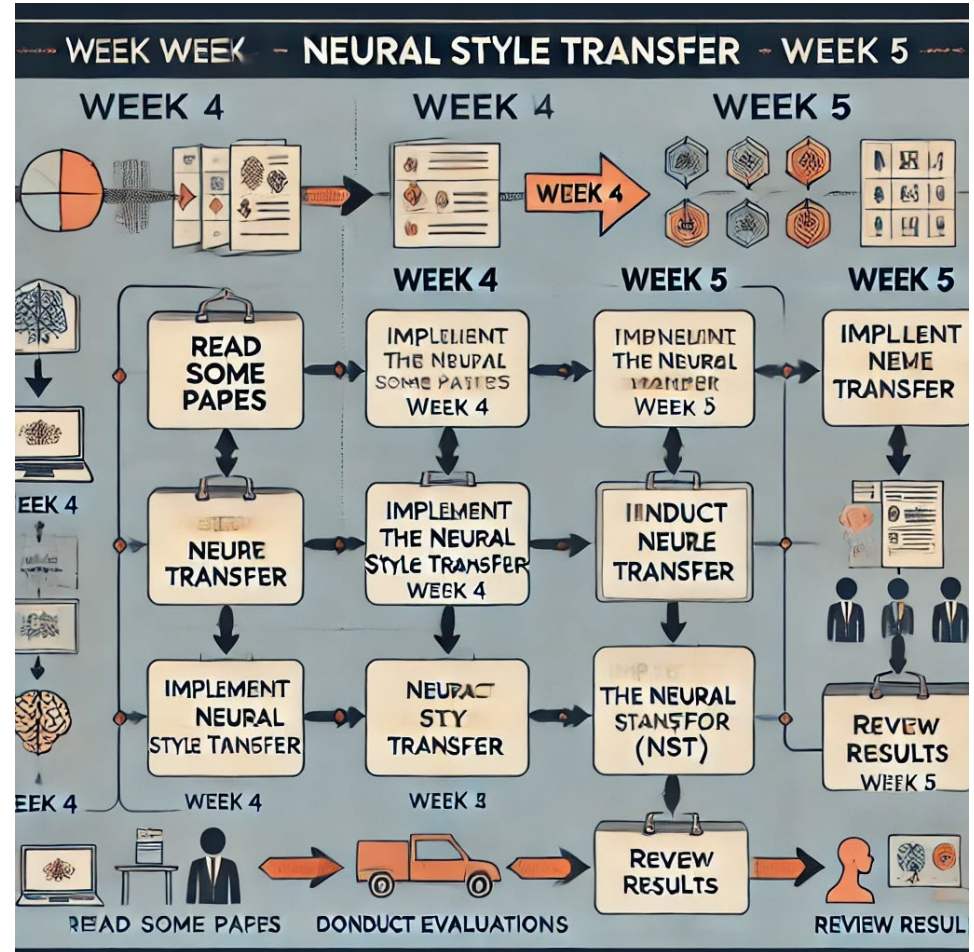
Timeline

Week4:

Read some papers

For the prensentation

Week5:

Implement the Netural Style Transfer

Do some evaluations

Neural Style Transfer Conclusion

- Application

- Introduction

- Motivation

- Related work

- Methodology

- conclusion

Reference

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Reference

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- [13] Shorten, C. (2019, February 13). Towards fast neural style transfer. Medium. https://towardsdatascience.com/towards-fast-neural-style-transfer-191012b86284

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Thanks for watching

Title name: Neural Style Transfer

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