A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is a light green. They are positioned diagonally, with the blue one partially covering the green one.

Implementing Convolutional Neural Network and Neural Style Transfer from Scratch

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Context

1. The Problem
2. CNN
3. NST
4. VGG19
5. Losses
6. Results
7. Conclusion and Future work



The Problem

Problem:

- Implementing CNN from scratch
- Implementing NST from scratch



What is a CNN?

- A type of deep learning model specialized for **image & spatial data**
- Inspired by the human visual system



Why CNNs?

- Automatically learns **features** (edges, shapes, objects)
- Reduces manual feature engineering
- Excellent performance in:
 - Image classification
 - Object detection
 - Face recognition



CNN Architecture Overview

- Main building blocks:
 - Convolution Layer
 - Pooling Layer
 - Fully Connected Layer
 - Output Layer



What is NST?

- AI technique that **combines the content of one image** with the **style of another image**
- Example: A photo painted in Van Gogh's style



Why Neural Style Transfer?

- Creates artistic images with deep learning
- Bridges art and technology
- Applications:
 - Digital art
 - Photography filters
 - Entertainment & design



Key Idea

- **Two inputs:**
 - **Content image** (e.g., your photo)
 - **Style image** (e.g., Van Gogh's Starry Night)
- **Output:** A new image = Content + Style



Underlying Technology

- Based on **Convolutional Neural Networks (CNNs)**
- CNN layers capture:
 - Lower layers → edges, textures (style)
 - Higher layers → objects, shapes (content)



The Loss Function

- Total loss = Content Loss + Style Loss (+ sometimes TV loss)
- Optimizes image to minimize this loss
- Balances “looking like the photo” vs “looking like the painting”



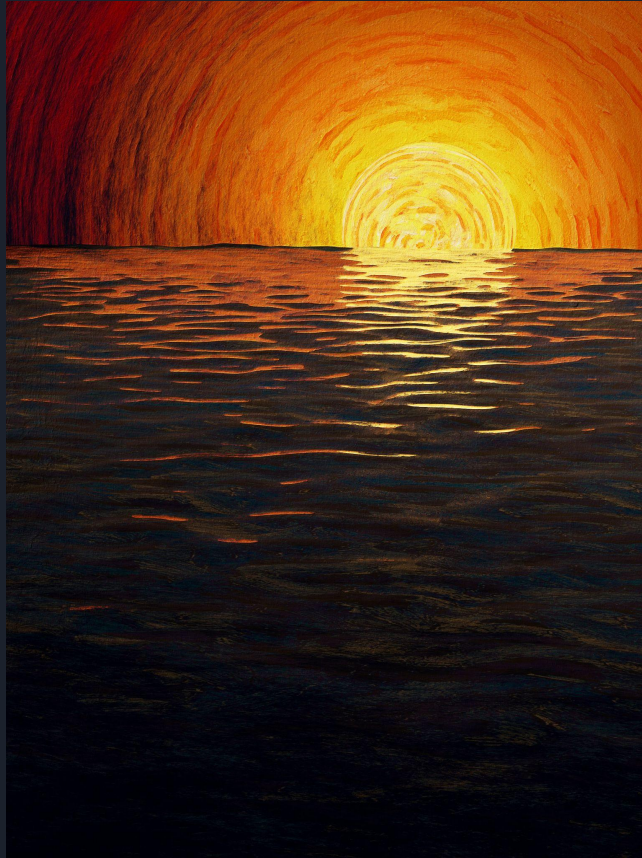
End-to-End Process

- Take content & style images
- Pass through CNN (like VGG-19)
- Compute losses
- Iteratively update the generated image
- Final stylized image

Results



Results



Results





Conclusion

- **Convolutional Neural Networks (CNNs):**
 - Core architecture for computer vision
 - Automatically extracts features (edges → objects)
 - Powers tasks like classification, detection, and recognition
- **Neural Style Transfer (NST):**
 - Creative application of CNNs
 - Blends **content** (structure) with **style** (textures, colors)
 - Bridges deep learning and artistic expression
- **Takeaway:**
 - CNNs provide the **foundation**
 - NST shows how these models enable both **practical** and **creative** applications of AI



Future Work

- **For CNNs:**
 - Improve **efficiency** with lightweight models (e.g., MobileNet, EfficientNet)
 - Better **explainability** and interpretability of learned features
 - Integration with **multimodal AI** (vision + text + audio)
 - Applications in **medical imaging, robotics, autonomous systems**
- **For NST:**
 - **Faster real-time style transfer** with more stable outputs
 - **Multi-style & dynamic blending** in a single model
 - Style transfer for **videos & 3D content**
 - Applications in **creative industries, AR/VR, gaming**



Thank you!