Neural Style Transfer

An Improved method of art generation.

A brief Introduction to Style Transfer

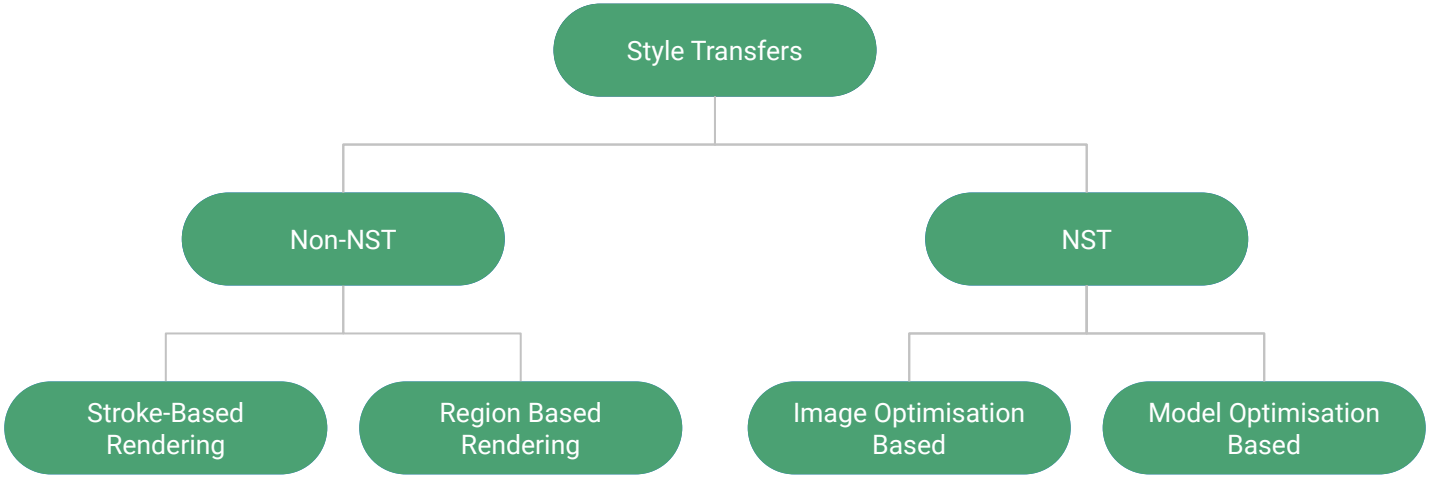
Style transfer is a Computer Vision methodology that is used to recompose the content of an image in a different visual format.It takes two images—a ***content image*** and a ***style reference*** *image*—and blends them together so that the resulting output image retains the core elements of the content image, but appears to be “painted” in the style of the style reference image.

Taxonomy

Of Neural Style Transfer

Style transfer has been till now achieved broadly with Neural Networks and as well as with Image Analogy.

Classification of Style Transfer Techniques



Non Neural Style Transfer

Stroke Based Rendering

- Style rendering of a photograph on some particular style with virtual strokes.
- The process starts with a source photograph.
- Then incrementally composites strokes to match the photo.
- Finally producing a non-photorealistic imagery which looks like the photo but with artistic style.

Region Based Rendering

- Incorporates region based segmentation to enable render adaptations.
- Region based algorithms exploit the shape of the regions to set stroke placement.
- Then the geometry of the shapes are rendered for artistic styles.
- Finally producing shape rendered effects by replacing them with canonical forms.

Neural Style Transfer

Image Optimisation Based

- First model and extract style and content information from corresponding content and style image.
- Recombine them to form the target image
- Iteratively construct the stylised image.

Model Optimisation Based

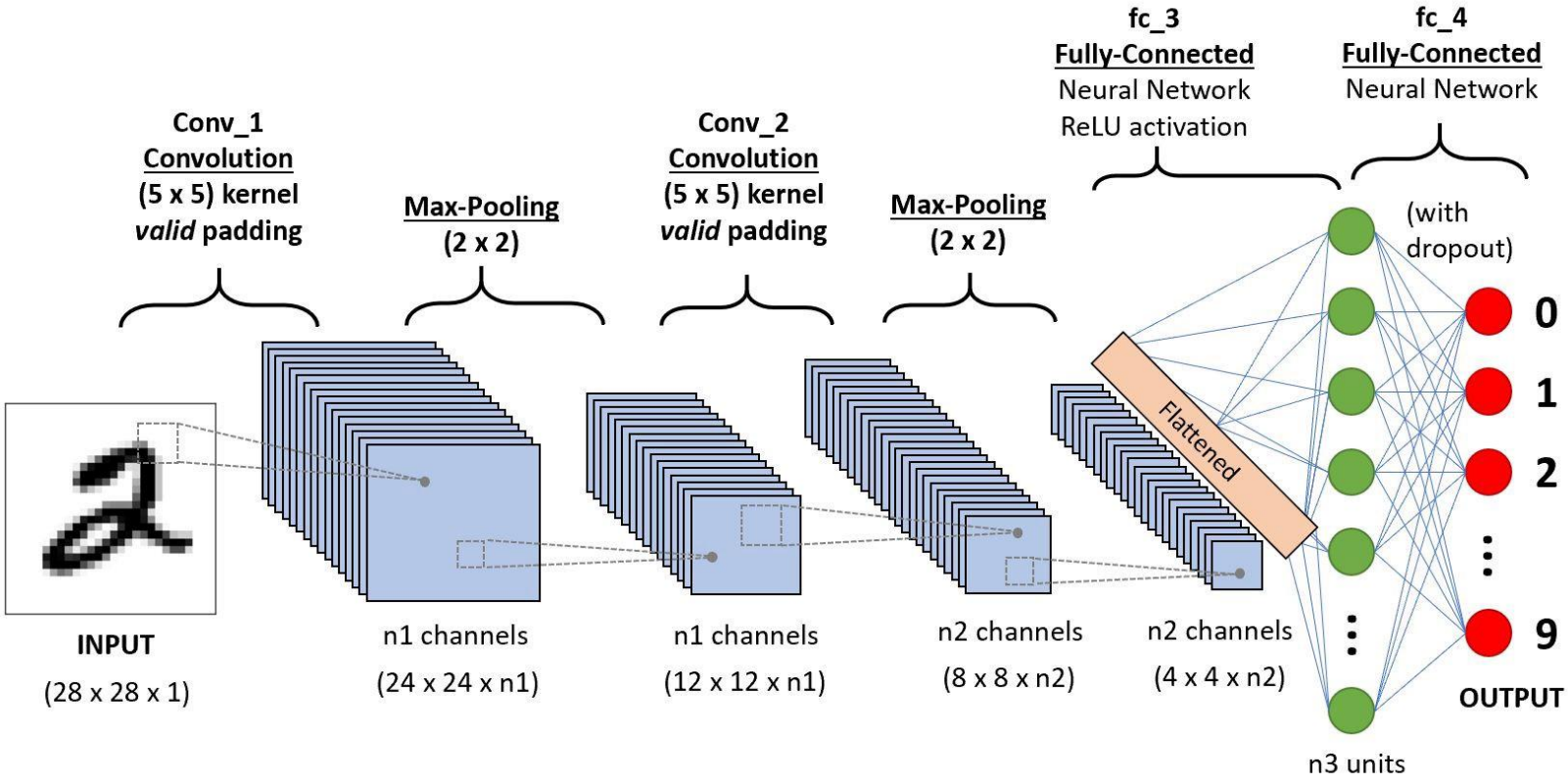
- Image Optimisation Based style transfer had speed and computation cost issues.
- To overcome that MOB-NST was introduced.
- This has been resolved by using a multi scale architecture.

How Neural Style Transfer Works?

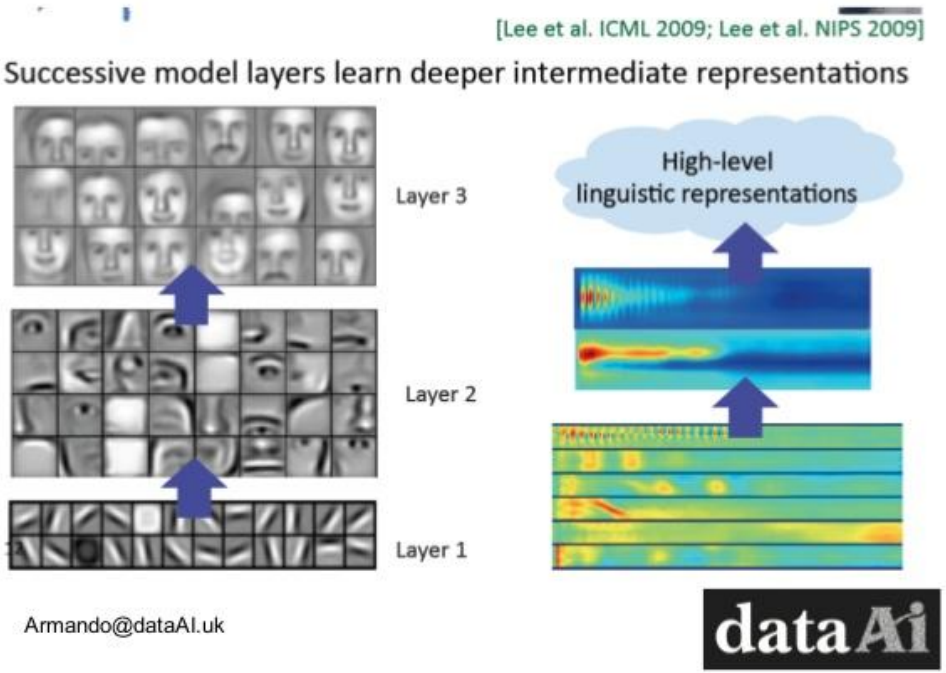
Before going into NST, let's understand what Convolution Neural Network does actually.

- What is Convolution Neural Network?
- What a CNN does?
- How NST uses CNN?

What is Convolution Neural Network?



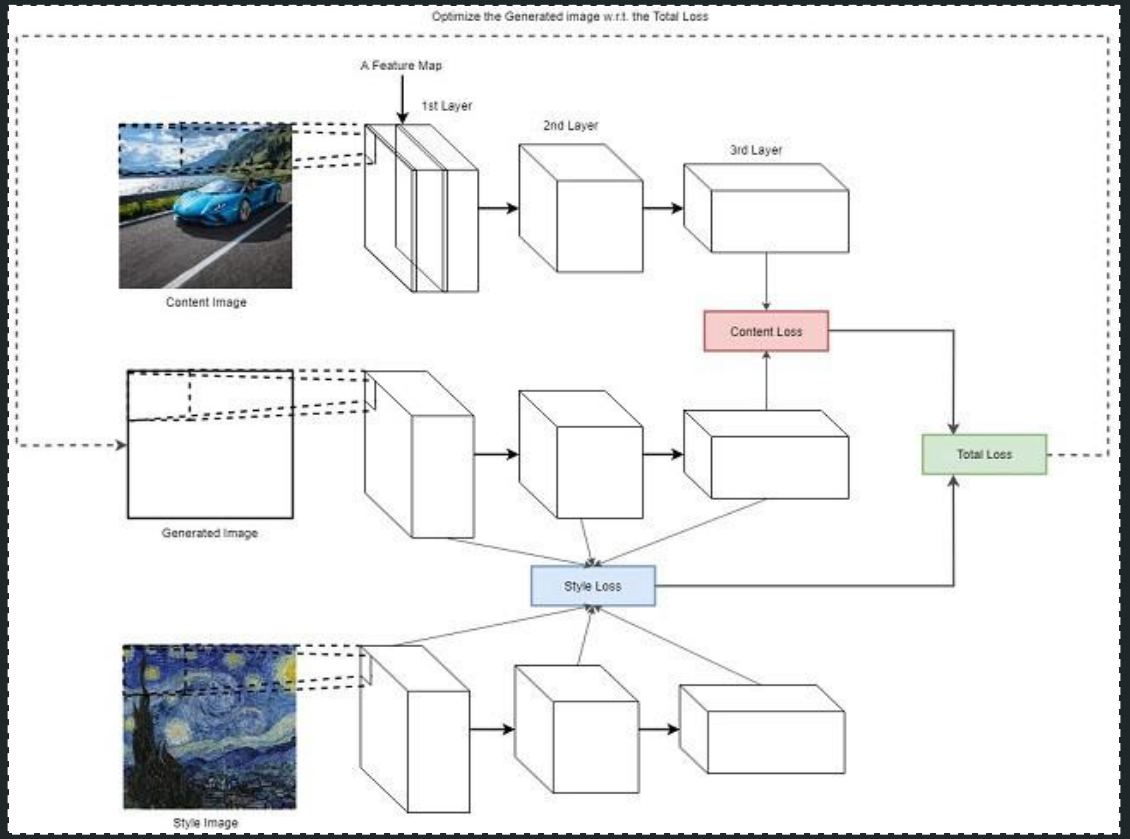
Visualization of CNN



The figure shows the visualization of the edge detection in different layers of CNN.

How NST uses CNN?

- **CNN** layers is used to detect the edges of an input image.
- Here it is used to extract style loss and contest loss
- Further it is used to combine two loss to find total loss.
- Total loss is used to generate the transferred styled image.



VGG16

Architecture

VGG16 is a convolution neural net (CNN) **architecture** which was used to win ILSVR (Imagenet) competition in 2014. It is considered to be one of the excellent vision model **architecture** till date.

Proposed Work

Potential improvisations on the Neural Style Transfer(NST) algorithm using MISH.

The algorithm of NST uses **ReLU** as an activation function. We will be using **MISH activation** instead of ReLU to produce better results and work better than both ReLU and Swish along with other standard activation functions in many deep networks across challenging datasets.

Mish

A Self Regularized Non-Monotonic Neural **Activation Function**

$$f(x) = x \cdot \tanh(\varsigma(x))$$

where, $\varsigma(x) = \ln(1 + e^x)$, is the Softplus activation function.

Mish is bounded below and unbounded above.

Range [≃ **-0.31, ∞)**.

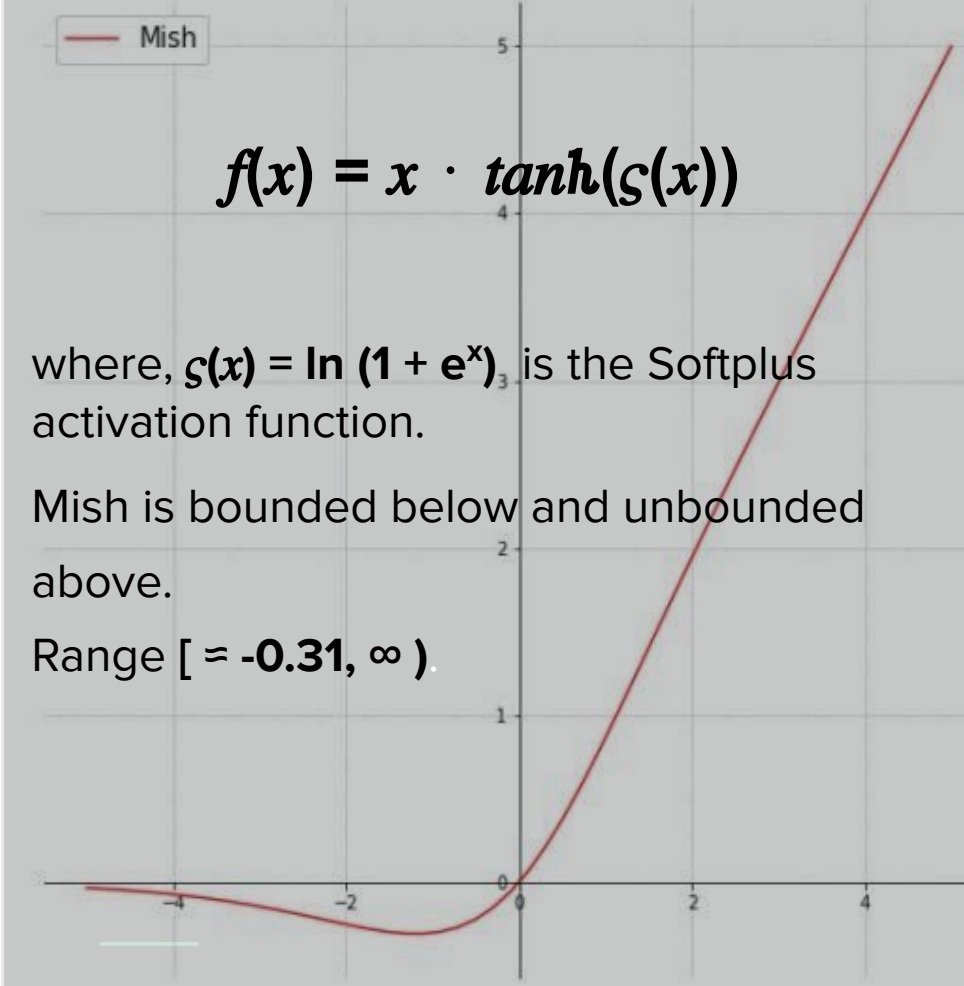
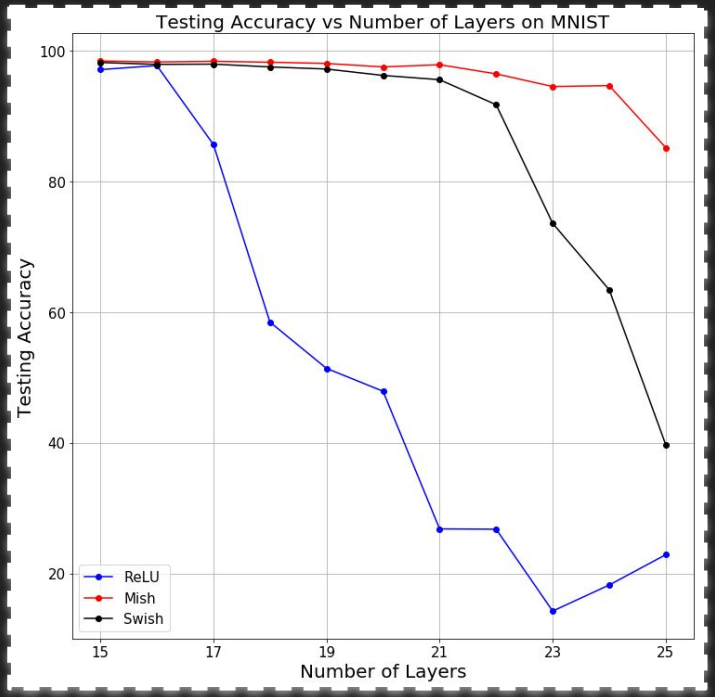


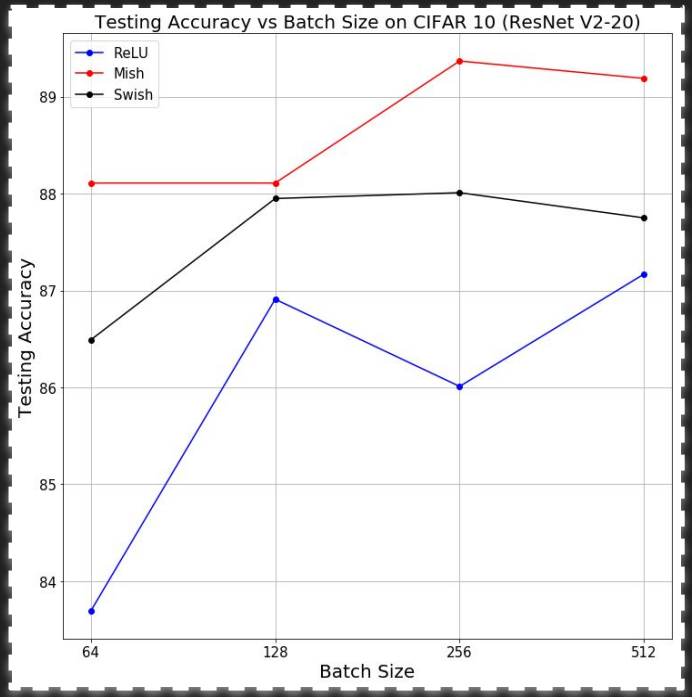
Figure 1. Mish Activation Function

Why Mish over ReLU?

ACCURACY on MNIST



ACCURACY on CIFAR-10



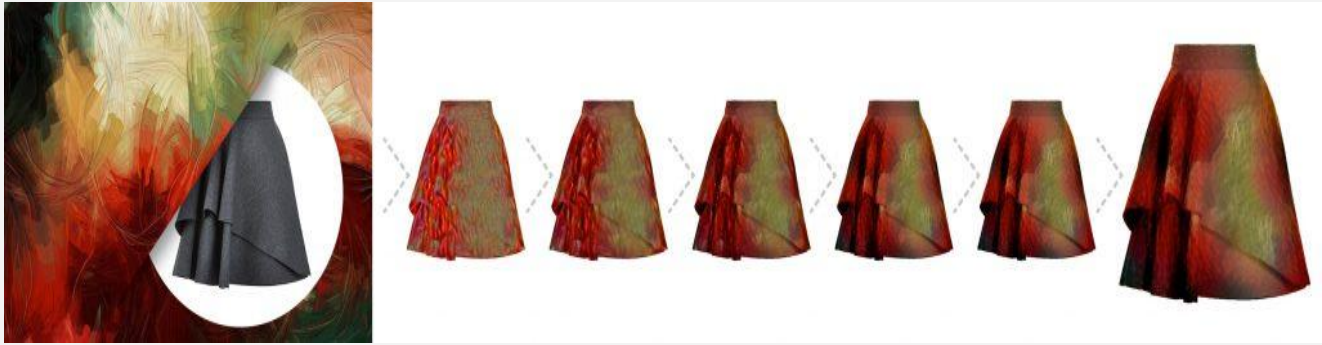
Applications

In Industries

- **Textile Industries** or professions that design clothing materials can use NST to brew better quality designs.
- **Improved Captcha Verification Systems** using NST on Captchas to improve security.
- **Photo-Editing** and **Art Industries** could engage businessmen to invest in such application.

Usage in Textile Industries

Textile Industries or professions that include designing clothing materials can use Neural Style Transfer to a large extent. Their main focus is to generate new designs to fly in the market. Designs can be made better by applying such highly developed algorithms to showcase out such style-based prints. In a nutshell, the designing industries will benefit a lot, when they make them change their methods of design generation to NSTs.



Some examples of Style Transfer on Apparel to generate better designs.

Stronger Captcha Verification System

We could bring out a differently styled image using NSTs and that could actually make pre-designed bots get confused between the ordinary image and a new style changed image. This could prove to be a stronger captcha verification system.

Photo - editing and Art Industries

We have lots and lots of android and IOS application that we developed in the past years and highly focused on changing styles of Images to allow users to have fun by applying improved and enhanced filters over the images. These industries got a chance to make profits by displaying advertisements on their applications and earned a lot.

Existing Related Applications

- **DeepArt.io** is a website that allows users to create unique artistic images by using an algorithm to redraw one image using the stylistic elements of another image.

- **Prisma** is a photo-editing application that uses neural network and artificial intelligence to transform the image into an artistic effect.

- **Google DeepDream** is a much more advanced version of the original Deep Dream approach. It is capable of using its own knowledge to interpret a painting style and transfer it to the uploaded image.

Thank You!