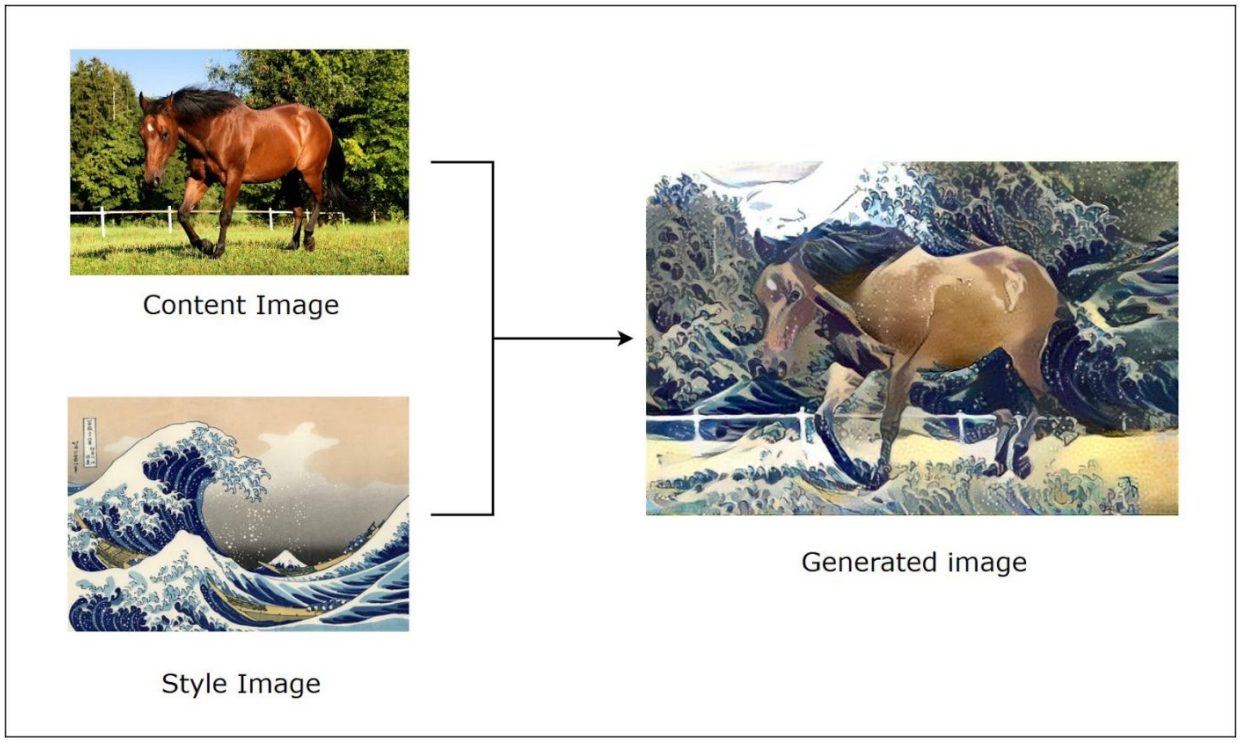
Neural style transfer - creating art with deep learning



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Video URL:

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Final Project : INFO 7374 Special topics in AI

Overview - need

Style transfer is the technique of recomposing images in the style of other images. Painterly transfer that separates style from the content of an image by considering different layers of a neural network. This model constrains the transformation from the input to the output to be locally affine in colorspace, and to express this constraint as a custom fully differentiable energy term. This approach will suppresses distortion and will give photorealistic style transfers in a broad variety of scenarios, including transfer of the time of day, weather, season, and artistic edits. This technique is to train a deep neural network to separate artistic style from image structure, and combine the style of one image with the structure of another. A convolutional neural network (CNN) can be used to "paint" a picture that combines the "content" of one image with the "style" of another. The convolution layers in a CNN have filters which abstract out aspects of an image. It turns out that we can use certain layers to extract the "content" of an image and others to extract the "style."

Goals

To provide some helpful information - things that we wish we could know - to the general public.

1. To understand the layers in neural network combining convolution layers to optimize algorithm for domain specific applications, enhance, introduce noise, extract colours, etc
2. Create a web application to provide real-time image transformations with good visualization to user.
3. Understand keras framework for its implementation - eager extraction

4. Understand and present feature maps in our network
5. Understand “content loss” and “style loss” and tune the parameters to obtain desired effects and visualize them.

Use Cases

Medical and research applications - Generate images with noise to train the model for image classification and other research applications.

Real-time - The Neural-Network will be designed to provide a real-time image transformation

Animations for movies - The effects obtained can be applied to generate exceptional visual effects.

Generate data for face recognition - Identifying the original face from a manipulated face, will need a training of model over blurred/ spotty image.

Data

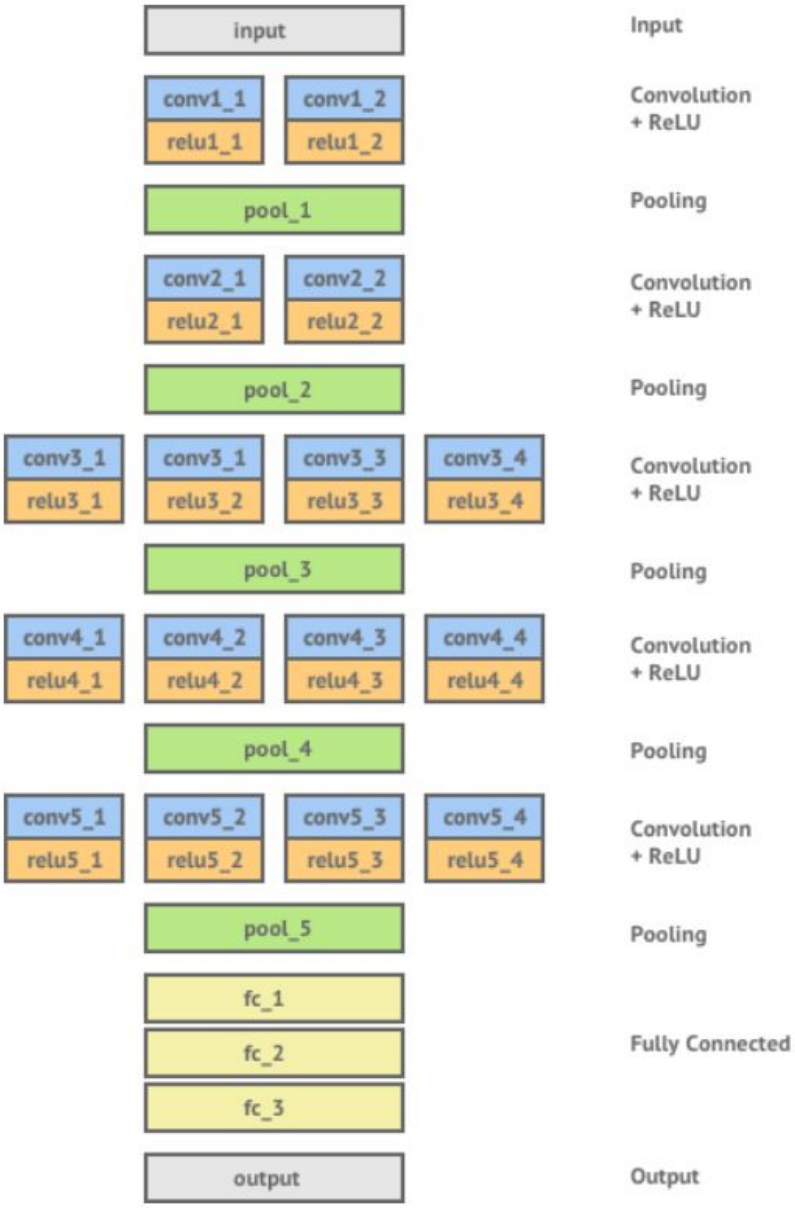
1. **ImageNet Dataset:** http://image-net.org/

ImageNet project is a large visual database designed for use in visual object recognition software research. As of 2016, over ten million URLs of images have been hand-annotated by ImageNet to indicate what objects are pictured. ImageNet crowdsources its annotation process.

A sample of the ImageNet dataset.

2. **VGG Net**

VGG Net was introduced as one of the contenders in 2014's ImageNet Challenge. VGG Net secured the first and the second places in the localisation and classification tracks respectively. It was later described in great detail in a paper that came out the following year. The paper describes how a family of models essentially composed of simple 3x3 convolutional filters with increasing depth (11–19 layers, ReLU not shown for brevity) managed to perform so well at a range of computer vision tasks.

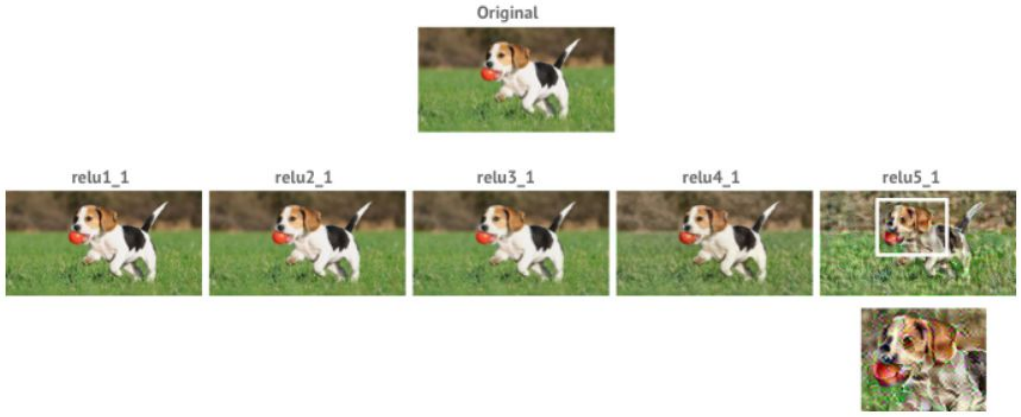


3. **WikiArt Data:** https://www.wikiart.org/

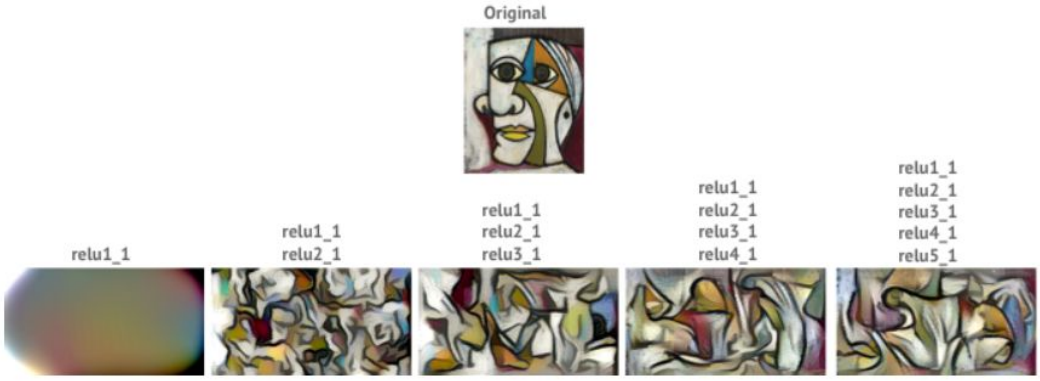
We will use images with different artistic styles obtained from WikiArt for test/evaluation purpose. If we have time, we would like to based on those images to generate an application.

Process Outline

1. Obtain & Visualize the Data/Image
2. Preprocess/Prepare Data According to the VGG Training Process
3. Study of the Content representation & Loss and Build Model



4. Study of Style representation & Loss and Build Model



5. Optimizing Loss Function and Styling the Image
6. Try TensorFlow's Imperative Programming Environment(Eager Execution) to Evaluates Operations Immediately
7. Build an Application to Demonstrate the Artistic Style Transfer and Results.

Milestones

Timeframe	Delivery
Day 1-2	- Obtain & Visualize the Data/Image - Preprocess/Prepare Data According to the VGG Training Process
Day 3-7	-Study of the Content representation & Loss - Study of the Style representation & Loss -Build the Model
Day 8-10	- Try TensorFlow Imperative Programming Environment(Eager Execution) - Evaluates Operations Immediately
Day 10-14	- Build an Application to Demonstrate the Artistic Style Transfer and Results

Deployment Details:

1) Language: Python
2) Tools for Analysis: Keras Functional API
3) Implementation: Google Colab, TensorFlow
4) Other Modeling Consideration: Models with instance normalization
5) Other Cloud Tools Considerations: GPU Acceleration, Google Cloud Platform

Artistic Style Transfer Modeling Results will look like:

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