Universal Style Transfer via Feature Transforms

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Approach

- Aims to synthesize an image that preserves some notion of the content image but carries characteristics of the style image.

We design a universal style transfer pipeline in 3 steps -

- Reconstruction
  - Encoder and Decoder
- Single level Stylization
  - Whitening and Coloring Transform
- Multi level Stylization

In each intermediate layer, our objective is to transform the extracted content features such that they exhibit the same statistical characteristics as the style features of the same layer.

Reconstruction
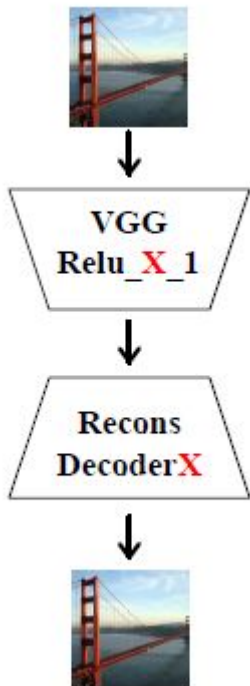
- We use the VGG-19 network as the feature extractor (encoder), and train a symmetric decoder to invert the VGG-19 features to the original image.
- We trained all the 5 layers using Microsoft COCO dataset.
- To evaluate with features extracted at different layers, we select feature maps at five layers of the VGG-19, i.e., Relu_X_1 (X=1,2,3,4,5), and train five decoders accordingly.
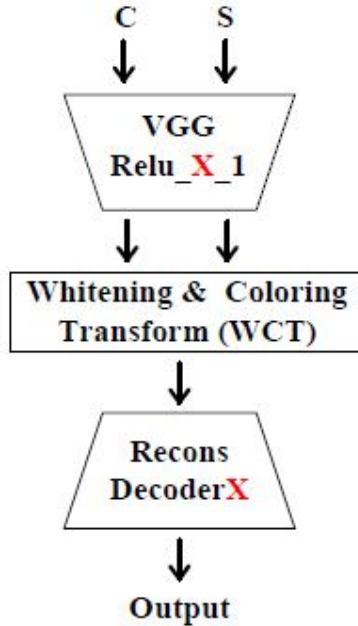- Loss function used is

$$L = \|I_o - I_i\|_2^2 + \lambda \|\Phi(I_o) - \Phi(I_i)\|_2^2$$

where ϕ is the VGG encoder that extracts the Relu_X_1 features.
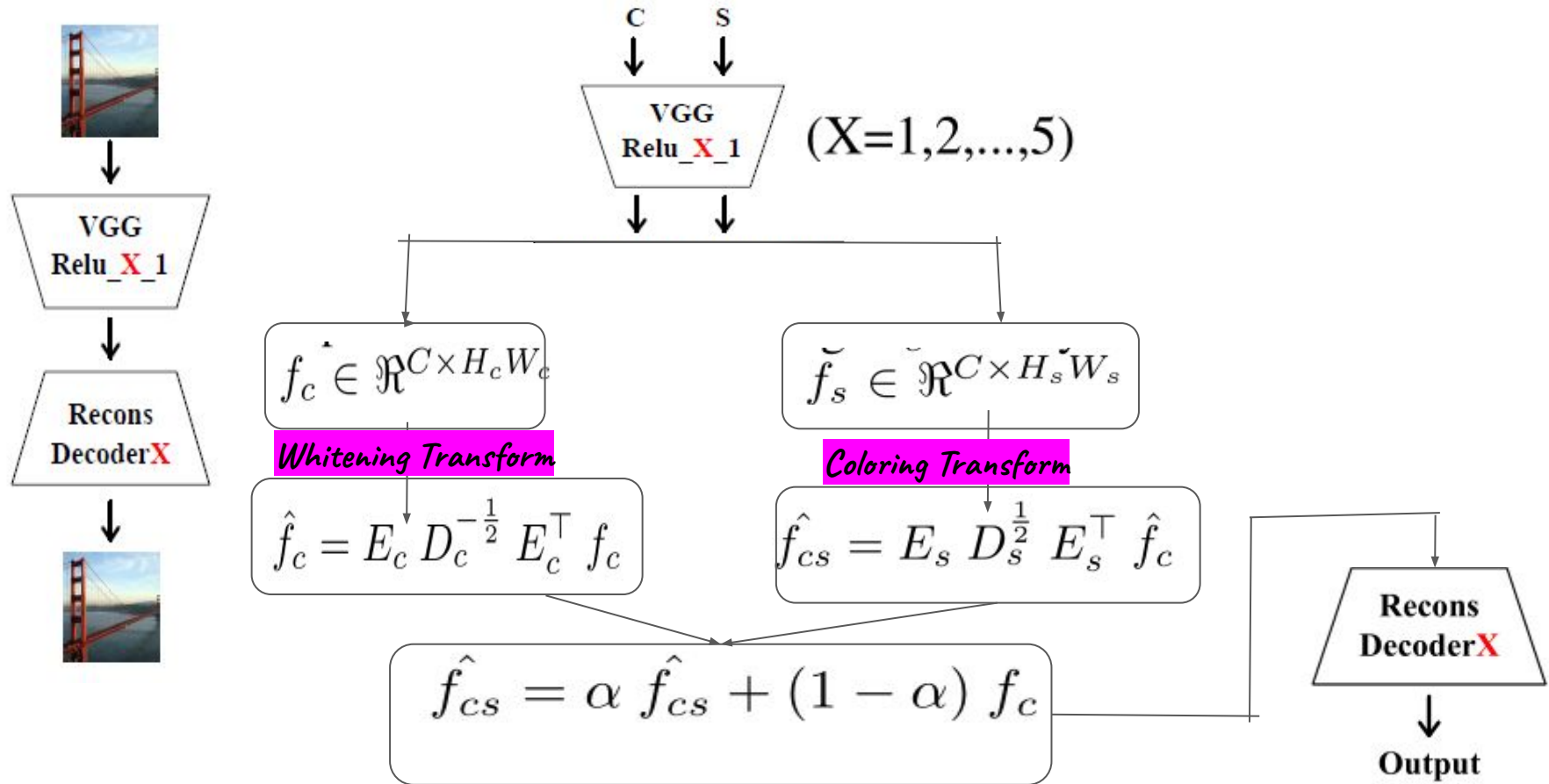- Once trained, encoder and decoder are fixed through all the experiments.

Work to be done

Single level stylization

- Given a pair of content image I_c and style image I_s, we first extract their vectorized VGG feature maps f_c and f_s at a certain layer (e.g., Relu_4_1), where H_c, W_c (H_s, W_s) are the height and width of the content (style) feature, and C is the number of channels.
- The decoder will reconstruct the original image I_c if f_c is directly fed into it.
- Now we use WCT to directly transform the f_c to match the covariance matrix of f_s.
- First we apply the whitening transform and make the covariance matrix to Identity..
- Now we apply the Coloring transform to match the covariance matrix to that of the style image.

Overall Flow Diagram

Thank You