

Neural Style Transfer

Junhao Zeng, Jingqiang Wang, Jinlin Xiang



Introduction

- Human artists usually master special painting skills to create a picture with a unique style, like oil painting, abstract painting and impressionist painting.
- Our work is to transfer the style of one picture (content picture) according to a new given picture(style picture)
- Appling convolution neural networks to transfer an image into feature map and generate new transferred image by optimizing the lose of style and content with gradient descent.

Method Map

Data Used

- Two images. Content image and style image which can transfer the content image into the style image's style.

Method Map

- General idea:** Take two images and produce a new image that reflects the content of one but in the artistic "style" of the other.
- Loss function:** The loss function is the sum of two part:

$$Loss = L_{content\ loss} + L_{style\ loss}$$

Content loss: Let $F^l \in R^{M_l \times C_l}$ be the feature map of the current output image and $P^l \in R^{M_l \times C_l}$ be the content source image (the original image), where $M_l = H_l \times W_l$. The loss will be calculated by L2 norm. Therefore, the loss function is given by

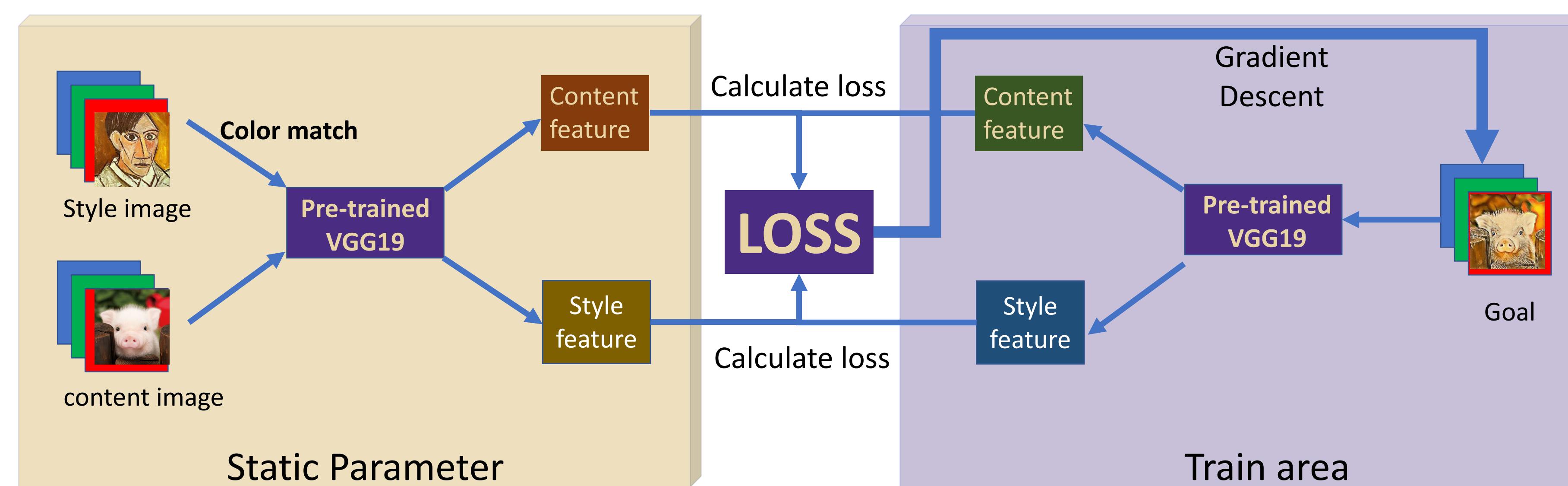
$$L_c = w_c \times \sum_{i,j} (F_{ij}^l - P_{ij}^l)^2$$

Style loss: The Gram matrix is an approximation of the covariance matrix which could be used to represent the 'style'.

$$G_{ij}^l = \sum_k F_{ki}^l F_{kj}^l$$

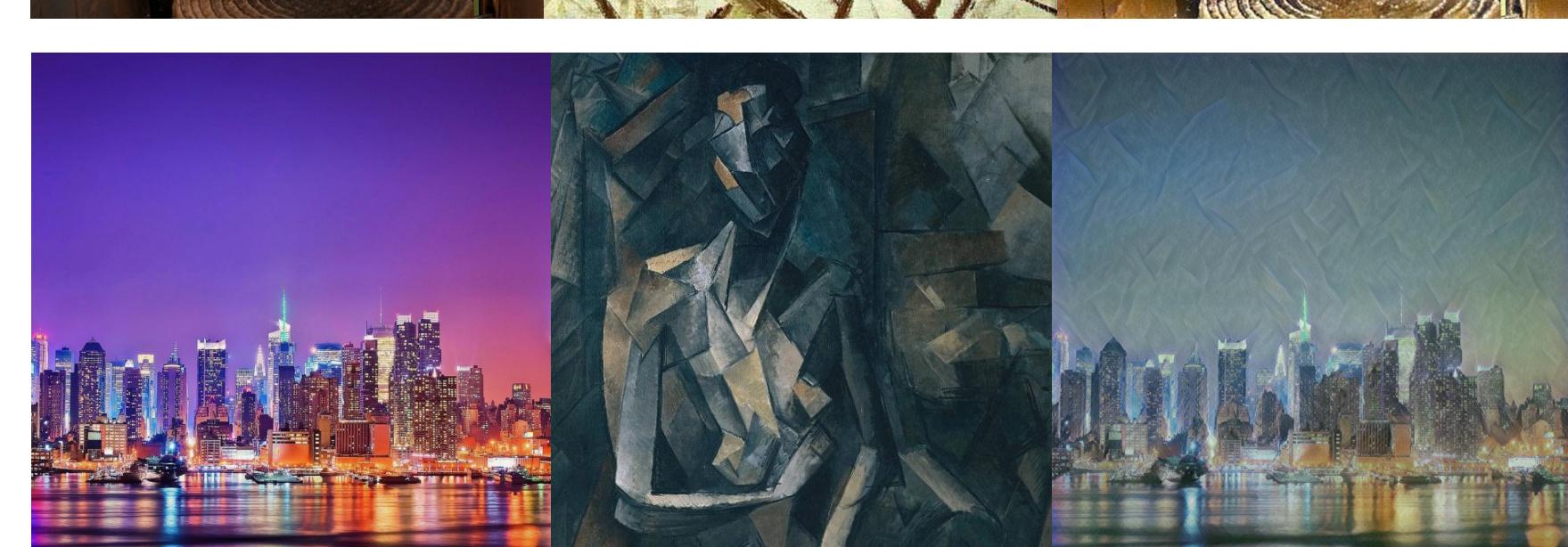
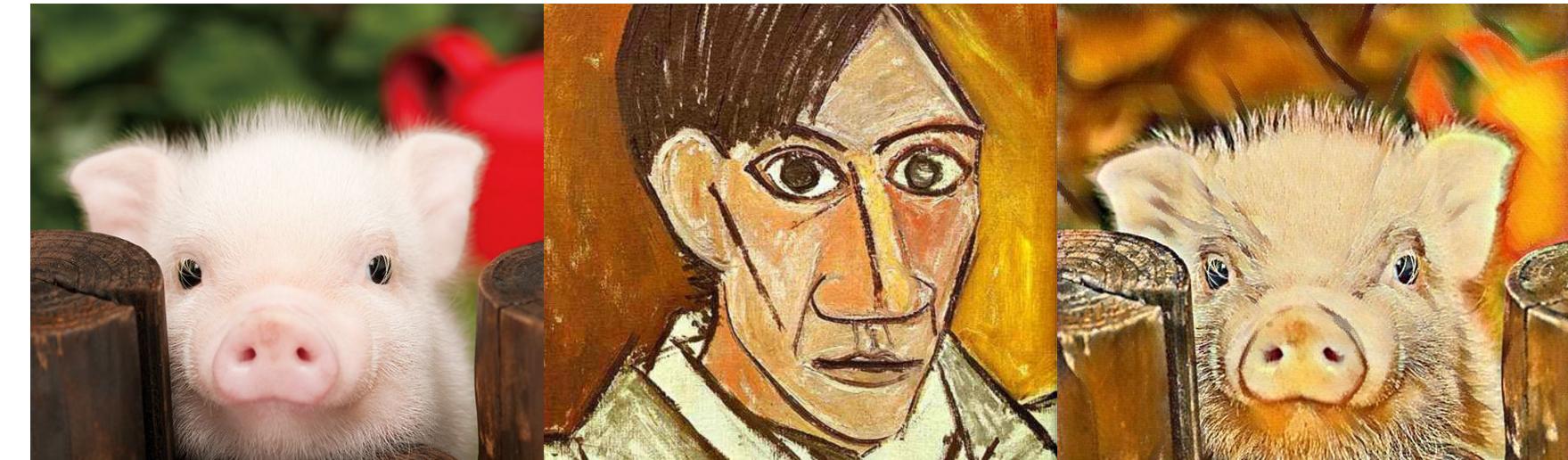
The style loss for the layer l is the sum of L2 norm of these two Gram matrices with weight:

$$L_s^l = w_l \sum_{i,j} (G_{ij}^l - A_{ij}^l)^2$$



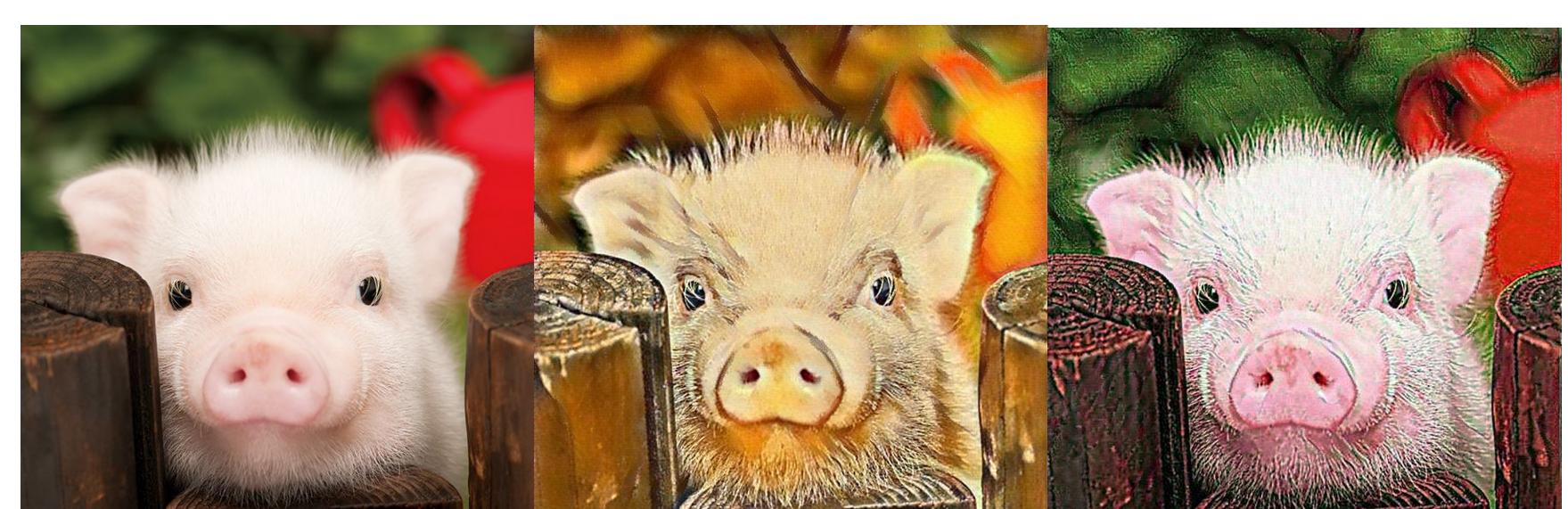
Result

All Neural Style Transfer:



Neural transformation without color changed:

Need to add color match function to transfer the style image color to content image color before calculating the style feature matrix.



Keeping color unchanged

- The method we used is transferring the RGB value of the style image so that the mean and covariance of style image matching the content image. This process is calculated by this linear process.

$$x_s' \leftarrow Ax_s + b$$

- We want to choose A and b to be satisfy $\mu_s' = \mu_c$ and $\Sigma_{s'} = \Sigma_c$.

$$\begin{aligned} b &= \mu_c - A\mu_s \\ A\Sigma_s A^T &= \Sigma_c \end{aligned}$$

Conclusion



- The style transfer algorithm performs an obvious changing on visual perspective. It demonstrates that the feature map got from the structure of CNN did represent the visual style of an image to a certain extent.
- The color keeps unchanged after color retained algorithm.
- The FNST take less time to compute the result, which is enough for an GXT1060 to generate a smooth transferred video.

Future work

- We could try to generate a segmentation result, which only make a specific part of the output to be transferred.
- From the perspective of software, we could develop an application that could get the picture from user, and thus improve the experience of users.

