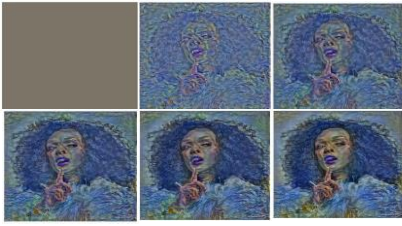
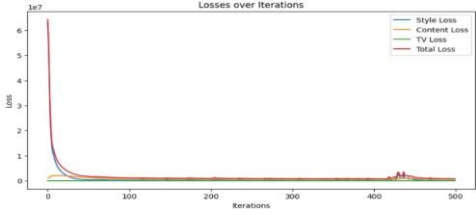
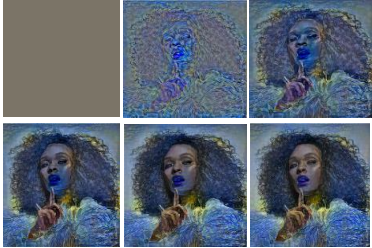
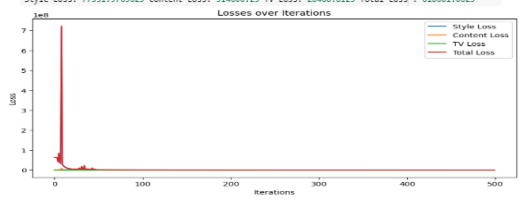

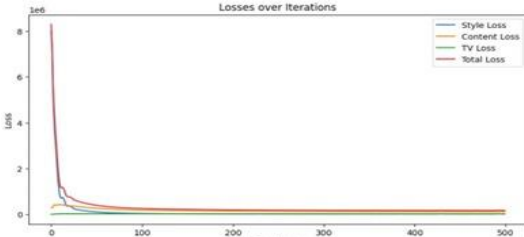
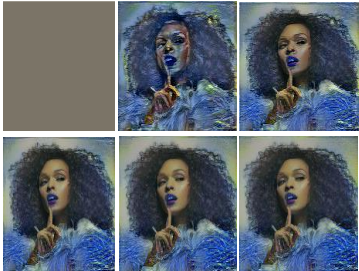
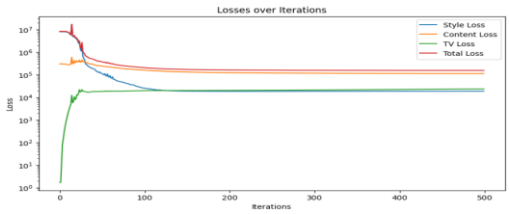

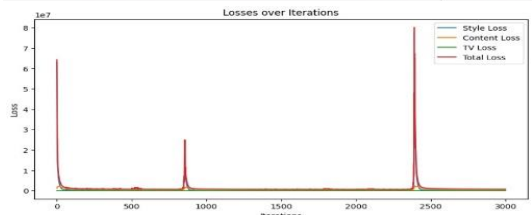
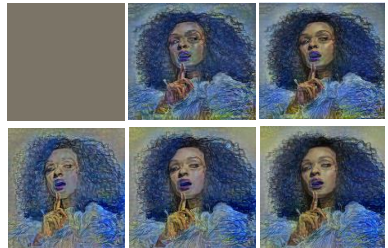
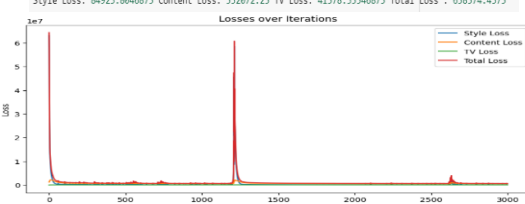
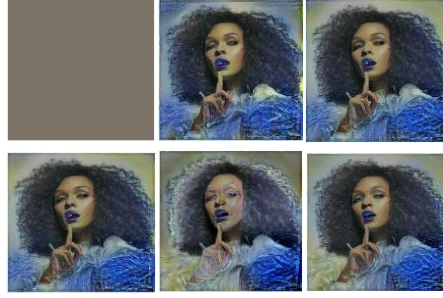


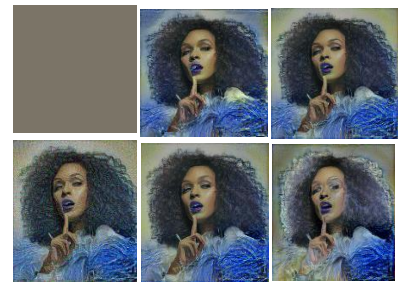
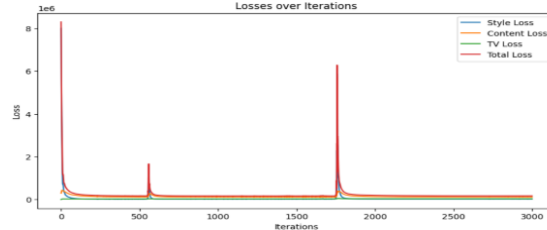
## RESULT ANALYSIS

	ReLU LAYERS	
Hyperparameter	ADAM Optimizer	LBFGS Optimizer
500 iteration Pooling: max weights: lr=10 alpha=5e0 beta=1e2 tv=1e-3	 <p>Style Loss: 63867564.0 Content Loss: 1237537.75 TV Loss: 1.6959991455078125 Total Loss : 64385180.0            Style Loss: 268648.25 Content Loss: 881982.4375 TV Loss: 31286.4375 Total Loss : 1181839.25            Style Loss: 184495.359375 Content Loss: 711884.25 TV Loss: 31265.47265625 Total Loss : 927645.125            Style Loss: 135582.98625 Content Loss: 644231.25 TV Loss: 31616.23846875 Total Loss : 811430.375            Style Loss: 181636.859375 Content Loss: 622633.875 TV Loss: 32172.7421875 Total Loss : 836443.5            Style Loss: 129598.1171875 Content Loss: 642242.5 TV Loss: 32788.781171875 Total Loss : 884549.3125</p> 	 <p>Style Loss: 63867568.0 Content Loss: 1237537.75 TV Loss: 1.6934564113616943 Total Loss : 64385184.0            Style Loss: 251448.921875 Content Loss: 871328.4375 TV Loss: 21187.576171875 Total Loss : 1143965.0            Style Loss: 111146.3515625 Content Loss: 632562.375 TV Loss: 22928.8846875 Total Loss : 766629.5625            Style Loss: 82541.339375 Content Loss: 568852.625 TV Loss: 24295.625 Total Loss : 667599.5625            Style Loss: 78007.4148625 Content Loss: 529825.6875 TV Loss: 25312.84375 Total Loss : 632346.0            Style Loss: 77531.9765625 Content Loss: 516800.25 TV Loss: 24688.8125 Total Loss : 618601.0625</p> 
	 <p>Style Loss: 8800398.5 Content Loss: 381288.875 TV Loss: 1.6958153247833252 Total Loss : 8381681.0            Style Loss: 38868.8984375 Content Loss: 188751.953125 TV Loss: 26955.826171875 Total Loss : 255977.671875            Style Loss: 21284.115234375 Content Loss: 146528.5625 TV Loss: 27676.864453125 Total Loss : 195480.734375            Style Loss: 28688.78783125 Content Loss: 128891.4453125 TV Loss: 27984.78783125 Total Loss : 177476.859375            Style Loss: 18898.77734375 Content Loss: 124375.21875 TV Loss: 27934.376953125 Total Loss : 170488.375            Style Loss: 18995.5625 Content Loss: 123977.2734375 TV Loss: 28872.125 Total Loss : 171844.96875</p> 	 <p>Style Loss: 8800398.5 Content Loss: 381288.8125 TV Loss: 1.6975393295288086 Total Loss : 8381681.0            Style Loss: 25127.2898625 Content Loss: 157734.96875 TV Loss: 19669.825398625 Total Loss : 282531.28125            Style Loss: 18248.88671875 Content Loss: 122428.109375 TV Loss: 28126.58398625 Total Loss : 168795.5            Style Loss: 18388.384765625 Content Loss: 116276.4921875 TV Loss: 28955.58894375 Total Loss : 155628.46875            Style Loss: 18545.91796875 Content Loss: 113744.34375 TV Loss: 22161.53125 Total Loss : 154111.796875            Style Loss: 18682.14648375 Content Loss: 112423.515625 TV Loss: 23392.421875 Total Loss : 154418.89375</p> 
3000 iteration Pooling: max weights: lr=10 alpha=5e0 beta=1e2 tv=1e-3	 <p>Style Loss: 63867564.0 Content Loss: 1237537.75 TV Loss: 1.6959992981635742 Total Loss : 64385180.0            Style Loss: 121789.7421875 Content Loss: 595296.5 TV Loss: 32291.581953125 Total Loss : 749297.75            Style Loss: 125128.53125 Content Loss: 647228.1875 TV Loss: 38811.96875 Total Loss : 811168.75            Style Loss: 88935.878125 Content Loss: 546883.5 TV Loss: 37773.984375 Total Loss : 673592.5625            Style Loss: 231889.546875 Content Loss: 828243.375 TV Loss: 58448.546875 Total Loss : 1110581.375            Style Loss: 186672.8546875 Content Loss: 584243.75 TV Loss: 47584.6171875 Total Loss : 738428.4375</p> 	 <p>Style Loss: 63867564.0 Content Loss: 1237537.875 TV Loss: 1.6968281133651733 Total Loss : 64385180.0            Style Loss: 101295.1171875 Content Loss: 598398.25 TV Loss: 32431.88546875 Total Loss : 724117.0            Style Loss: 87490.5546875 Content Loss: 545717.75 TV Loss: 33558.83283125 Total Loss : 666759.125            Style Loss: 135931.4375 Content Loss: 626758.6875 TV Loss: 44517.28515625 Total Loss : 887199.4375            Style Loss: 88858.689375 Content Loss: 552196.1875 TV Loss: 43173.21875 Total Loss : 682228.0            Style Loss: 84923.8846875 Content Loss: 532872.25 TV Loss: 41578.35546875 Total Loss : 658574.4375</p> 

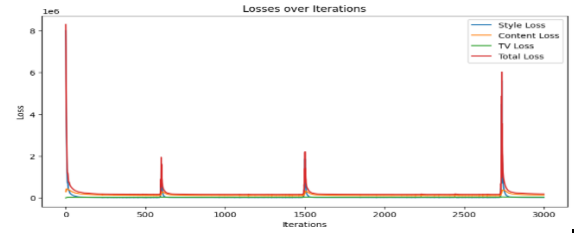
3000 iteration  
Pooling: avg  
weights:  
lr=10  
alpha=5e0  
beta=1e2  
tv=1e-3



Style Loss: 8000398.5 Content Loss: 301280.8125 TV Loss: 1.6976457834249774 Total Loss : 8301681.0  
Style Loss: 18689.751953125 Content Loss: 121167.734375 TV Loss: 28188.2578125 Total Loss : 167965.75  
Style Loss: 17960.484375 Content Loss: 117166.8828125 TV Loss: 29185.38859375 Total Loss : 164312.6875  
Style Loss: 18277.38640625 Content Loss: 114363.9921875 TV Loss: 38629.369140625 Total Loss : 163270.671875  
Style Loss: 28192.923828125 Content Loss: 134920.3125 TV Loss: 36135.84765625 Total Loss : 191249.078125  
Style Loss: 20999.578125 Content Loss: 111707.1484375 TV Loss: 35910.11328125 Total Loss : 167716.828125



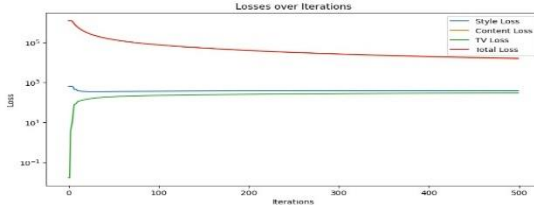
Style Loss: 8000398.5 Content Loss: 301280.8125 TV Loss: 1.6941224336624146 Total Loss : 8301681.0  
Style Loss: 18273.4609375 Content Loss: 122296.984375 TV Loss: 28143.23828125 Total Loss : 168713.671875  
Style Loss: 19010.916015625 Content Loss: 115126.890625 TV Loss: 29450.619140625 Total Loss : 163588.4375  
Style Loss: 1863090.25 Content Loss: 298276.34375 TV Loss: 33043.2734375 Total Loss : 2194409.75  
Style Loss: 19027.19921875 Content Loss: 112601.125 TV Loss: 32189.6640625 Total Loss : 163818.0  
Style Loss: 19920.255859375 Content Loss: 134381.546875 TV Loss: 36448.88671875 Total Loss : 190750.6875



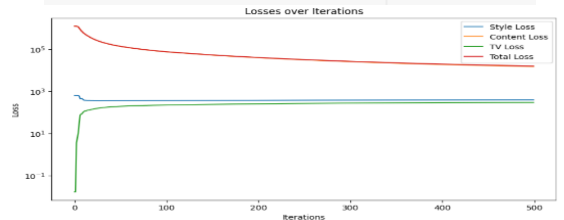
500 iteration  
Pooling: max  
weights:  
lr=10  
alpha=5  
beta=1e-3  
tv=1e-5



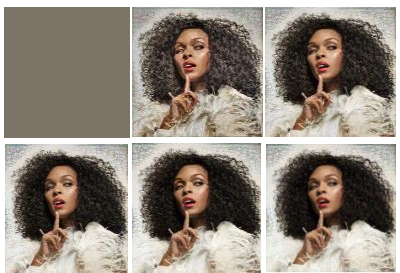
Style Loss: 630.6756591796875 Content Loss: 1237537.5 TV Loss: 0.01695158136947632 Total Loss : 1238168.125  
Style Loss: 350.7507813042969 Content Loss: 86818.9140625 TV Loss: 335.2191162109375 Total Loss : 87504.8828125  
Style Loss: 358.9154052734375 Content Loss: 65906.67578125 TV Loss: 340.7808837090625 Total Loss : 66214.375  
Style Loss: 362.795013427744 Content Loss: 57609.90234375 TV Loss: 362.447904941406 Total Loss : 58335.1484375  
Style Loss: 365.8236999511719 Content Loss: 54063.234375 TV Loss: 375.1016845783125 Total Loss : 54084.16015625  
Style Loss: 368.50994873046875 Content Loss: 49350.9236875 TV Loss: 385.90460209078125 Total Loss : 50105.34765625



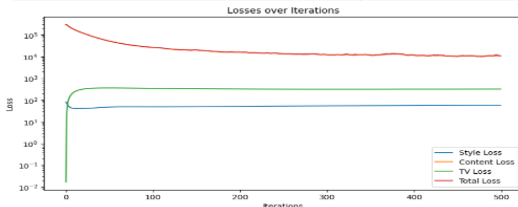
Style Loss: 630.6756591796875 Content Loss: 1237537.5 TV Loss: 0.0169466803562374 Total Loss : 1238168.125  
Style Loss: 362.23248291015625 Content Loss: 74628.5 TV Loss: 222.01707458406094 Total Loss : 75212.75  
Style Loss: 373.48858642578125 Content Loss: 39436.51171875 TV Loss: 253.6341094970703 Total Loss : 40063.6328125  
Style Loss: 380.6634216308594 Content Loss: 25690.51171875 TV Loss: 274.8467712402344 Total Loss : 26346.0234375  
Style Loss: 385.512298583984 Content Loss: 18861.34375 TV Loss: 288.161086234375 Total Loss : 19535.01758125  
Style Loss: 389.3044730769531 Content Loss: 15134.5078125 TV Loss: 295.1404445080781 Total Loss : 15819.0048828125



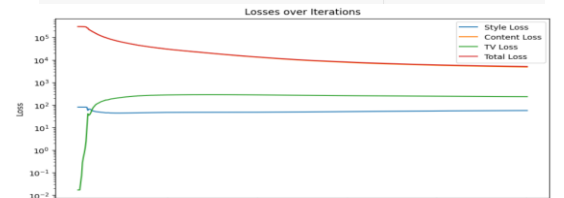
500 iteration  
Pooling: avg  
weights:  
lr=10  
alpha=5  
beta=1e-3  
tv=1e-5



Style Loss: 80.00399017333984 Content Loss: 301280.8125 TV Loss: 0.01694669376821510 Total Loss : 301360.84375  
Style Loss: 48.847721099853516 Content Loss: 26489.28515625 TV Loss: 345.6015905761719 Total Loss : 26883.794921875  
Style Loss: 50.9958000193105 Content Loss: 15748.9013671875 TV Loss: 322.5736389160156 Total Loss : 16122.470703125  
Style Loss: 54.20306777951016 Content Loss: 12011.8310546875 TV Loss: 316.0863025390625 Total Loss : 12382.9208984375  
Style Loss: 56.665302385253906 Content Loss: 11401.008078125 TV Loss: 319.9330804082031 Total Loss : 11777.6707109375  
Style Loss: 58.049991607660816 Content Loss: 10533.908203125 TV Loss: 322.31036376953125 Total Loss : 10914.2685546875



Style Loss: 80.00399017333984 Content Loss: 301280.75 TV Loss: 0.01694451351327896 Total Loss : 301360.78125  
Style Loss: 46.7065533939547 Content Loss: 29898.439453125 TV Loss: 270.1010473632081 Total Loss : 30223.248046875  
Style Loss: 47.558109283447266 Content Loss: 13105.4775390625 TV Loss: 279.7191467205156 Total Loss : 13432.7548828125  
Style Loss: 50.84256362915039 Content Loss: 7739.078125 TV Loss: 257.73583984375 Total Loss : 8047.65673828125  
Style Loss: 54.39376449584061 Content Loss: 5728.3002926875 TV Loss: 243.5904344483422 Total Loss : 6026.29248046875  
Style Loss: 56.63544045501055 Content Loss: 4813.5947265625 TV Loss: 234.0592083955070 Total Loss : 5104.2090625



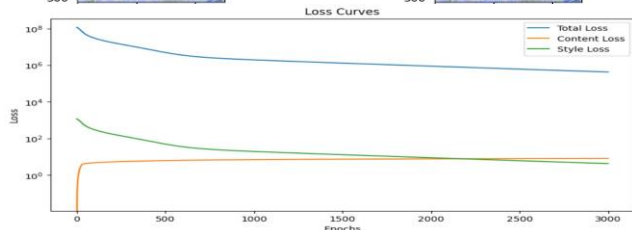
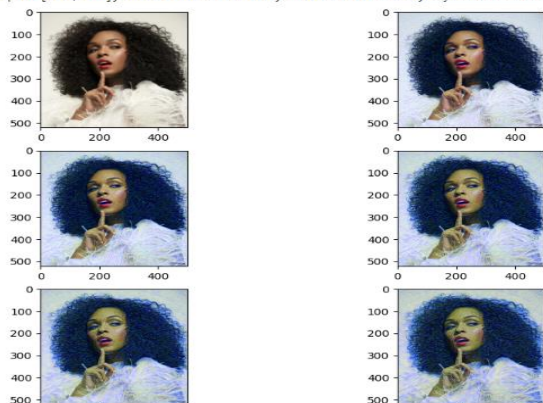


## CONVOLUTION LAYERS

### ADAM Optimizer

3000 iteration  
weights: lr=0.003,alpha=1,beta=1e5

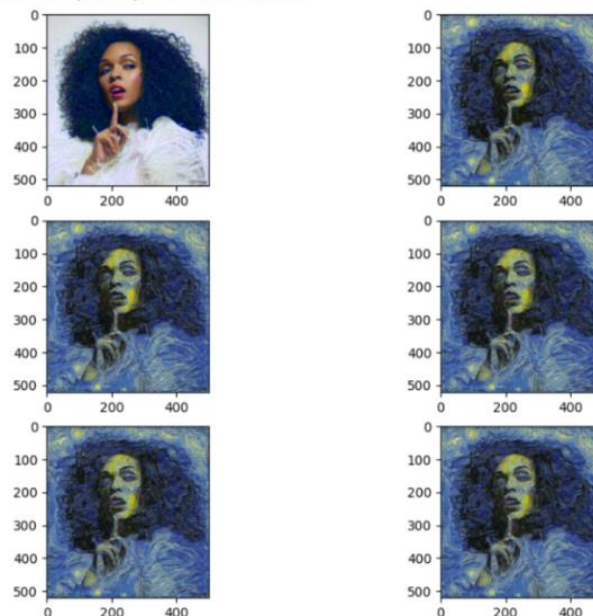
Epoch [0/3000], Total Loss: 115680520.0000, Content Loss: 0.0000, Style Loss: 1156.8052  
Epoch [500/3000], Total Loss: 4896123.0000, Content Loss: 6.1715, Style Loss: 48.9612  
Epoch [1000/3000], Total Loss: 1941137.5000, Content Loss: 6.9559, Style Loss: 19.4112  
Epoch [1500/3000], Total Loss: 1293001.2500, Content Loss: 7.3836, Style Loss: 12.9299  
Epoch [2000/3000], Total Loss: 882619.1250, Content Loss: 7.6749, Style Loss: 8.8261  
Epoch [2500/3000], Total Loss: 606954.0625, Content Loss: 7.9186, Style Loss: 6.0695



### LBFGS Optimizer

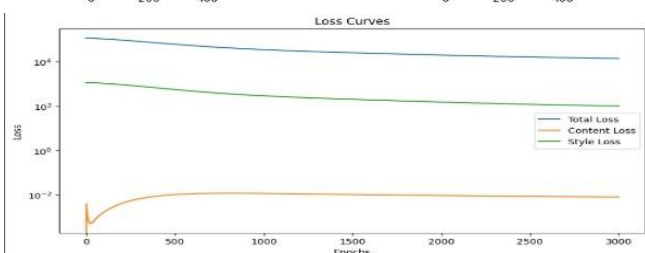
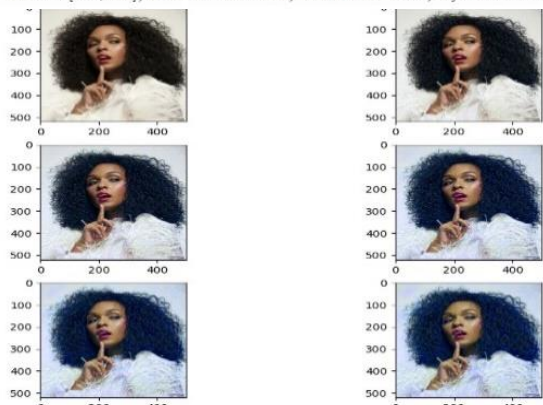
300 iteration  
weights: alpha=1,beta=1e5

Iteration [0/300], Total Loss: 4383994.5000  
Iteration [50/300], Total Loss: 6489.7646  
Iteration [100/300], Total Loss: 5028.2891  
Iteration [150/300], Total Loss: 4535.6646  
Iteration [200/300], Total Loss: 4297.6021  
Iteration [250/300], Total Loss: 4153.7207



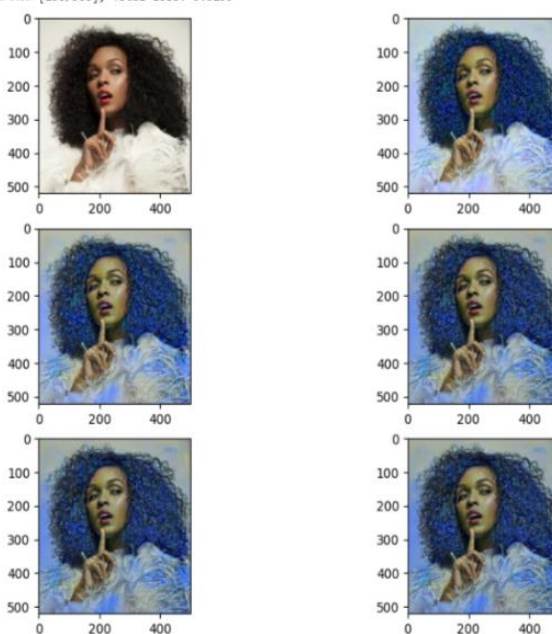
3000 iteration  
weights: lr=0.001,alpha=5e5,beta=1e2

Iteration [0/3000], Total Loss: 1156805.1250, Content Loss: 0.0000, Style Loss: 1156.8052  
Iteration [500/3000], Total Loss: 284855.6875, Content Loss: 0.0708, Style Loss: 248.6625  
Iteration [1000/3000], Total Loss: 156391.5000, Content Loss: 0.0522, Style Loss: 129.0138  
Iteration [1500/3000], Total Loss: 98397.2656, Content Loss: 0.0446, Style Loss: 76.1893  
Iteration [2000/3000], Total Loss: 73860.5312, Content Loss: 0.0393, Style Loss: 54.2069  
Iteration [2500/3000], Total Loss: 63264.0625, Content Loss: 0.0350, Style Loss: 45.4587



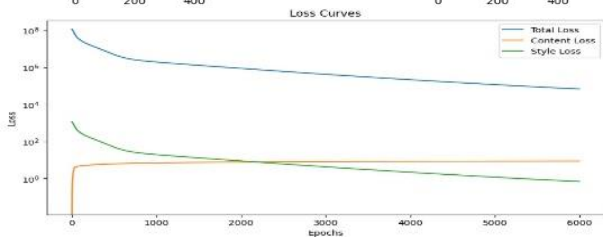
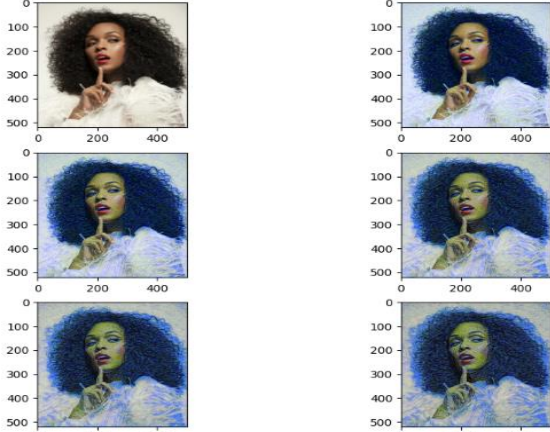
300 iteration  
weights: alpha=1,beta=0.001

Iteration [0/300], Total Loss: 1.0358  
Iteration [50/300], Total Loss: 0.0469  
Iteration [100/300], Total Loss: 0.0346  
Iteration [150/300], Total Loss: 0.0316  
Iteration [200/300], Total Loss: 0.0304  
Iteration [250/300], Total Loss: 0.0299



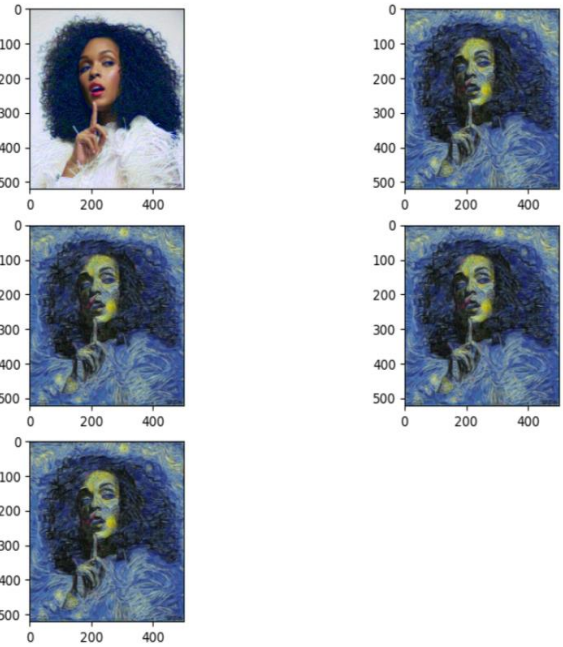
6000 iteration  
weights: lr=0.003,alpha=1,beta=1e5

Iteration [0/6000], Total Loss: 115680520.0000, Content Loss: 0.0000, Style Loss: 1156.8052  
 Iteration [1000/6000], Total Loss: 1948983.3750, Content Loss: 6.9595, Style Loss: 19.4898  
 Iteration [2000/6000], Total Loss: 88241.5625, Content Loss: 7.6882, Style Loss: 8.8243  
 Iteration [3000/6000], Total Loss: 423097.5312, Content Loss: 8.1125, Style Loss: 4.2309  
 Iteration [4000/6000], Total Loss: 216157.2969, Content Loss: 8.3863, Style Loss: 2.1615  
 Iteration [5000/6000], Total Loss: 117174.7188, Content Loss: 8.5713, Style Loss: 1.1717



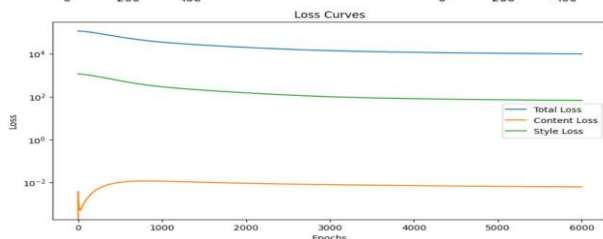
1000 iteration  
weights: alpha=1,beta=1e5

Iteration [0/1000], Total Loss: 5308006.5000  
 Iteration [200/1000], Total Loss: 4262.4429  
 Iteration [400/1000], Total Loss: 3935.6465  
 Iteration [600/1000], Total Loss: 3877.1897  
 Iteration [800/1000], Total Loss: 3855.0149



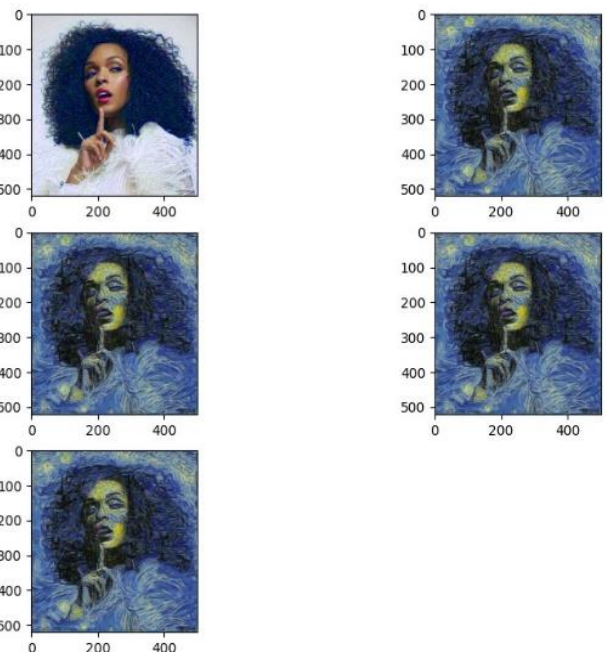
6000 iteration  
weights: lr=0.001,alpha=5e5,beta=1e2

Iteration [0/6000], Total Loss: 115680.5156, Content Loss: 0.0000, Style Loss: 1156.8052  
 Iteration [1000/6000], Total Loss: 34821.6797, Content Loss: 0.0116, Style Loss: 290.1237  
 Iteration [2000/6000], Total Loss: 19859.5559, Content Loss: 0.0092, Style Loss: 152.3782  
 Iteration [3000/6000], Total Loss: 14029.5400, Content Loss: 0.0080, Style Loss: 100.3280  
 Iteration [4000/6000], Total Loss: 11734.6221, Content Loss: 0.0072, Style Loss: 81.2722  
 Iteration [5000/6000], Total Loss: 10613.2617, Content Loss: 0.0067, Style Loss: 72.6217



1000 iteration  
weights: alpha=1,beta=5e5

Iteration [0/1000], Total Loss: 4368317.0000  
 Iteration [200/1000], Total Loss: 4292.1768  
 Iteration [400/1000], Total Loss: 3961.7681  
 Iteration [600/1000], Total Loss: 3904.2039  
 Iteration [800/1000], Total Loss: 3879.7854





## Vgg – 19 from Tensorflow

### SGD Optimizer

total\_variation\_weight = 1e-6  
style\_weight = 1e-6  
content\_weight = 2.5e-8  
iterations = 3000  
initial\_learning\_rate=100.0, decay\_steps=100,  
decay\_rate=0.96

total\_variation\_weight = 1e-6  
style\_weight = 1e-6  
content\_weight = 2.5e-8  
iterations = 3000  
initial\_learning\_rate=10.0, decay\_steps=50,  
decay\_rate=0.98

```
1: loss=8201.82
2: loss=7409.74
3: loss=7106.64
4: loss=6951.28
5: loss=6858.89
6: loss=6798.61
```



```
500: loss=3757.12
1000: loss=3158.35
1500: loss=1684.57
2000: loss=1621.89
2500: loss=1581.88
3000: loss=1554.33
```



The two sets of code provided are both implementations of neural style transfer, but they differ in several key aspects:

#### 1. Libraries:

- The first code uses PyTorch with torchvision for neural style transfer implementation.
- The second code also uses PyTorch but implements neural style transfer without relying on torchvision. It directly handles image processing and feature extraction.

#### 2. Model Architecture:

- In the first code, VGG19 is used for feature extraction. It loads the pre-trained VGG19 model from torchvision.
- The second code loads a VGG19 model but manually adjusts the pooling layers for feature extraction.

#### 3. Loss Functions:

- Both snippets use different loss functions. The first code snippet defines content loss and style loss functions using mean squared error (MSE) and gram matrix calculations.
- The second code snippet uses MSE loss for content and style losses and also includes total variation (TV) loss for spatial smoothness.

#### 4. Optimization:

- Both the code use Adam and lbfgs optimizers, where learning rate can be adjusted.

#### 5. Preprocessing and Postprocessing:

- The first code snippet preprocesses images using torchvision transforms and PIL, and it includes a function for deprocessing images after style transfer.
- The second code snippet has its own image preprocessing functions using OpenCV and torchvision transforms for converting images to tensors and vice versa.

#### 6. Color Preservation:

- The second code snippet includes an option for color preservation during style transfer, which is achieved through color transfer between the content and generated images.

### **Comparison between our results and Reference Result:**

#### 1. Style Loss:

- For the reference results:
  - Ranges from around 142009.94 to 51000864.0.
- For your results:
  - Ranges from around 140188.03 to 63067564.0.

Both sets of results show a significant variation in Style Loss across iterations. The Style Loss measures the difference between the style features of the style image and the generated image. A higher Style Loss indicates that the generated image is further away from the style target, which may result in less faithful style transfer.

#### 2. Content Loss:

- For the reference results:
  - Ranges from around 548498.38 to 1246539.0.
- For your results:
  - Ranges from around 608578.94 to 1237537.75.

Content Loss measures the difference between the content features of the content image and the generated image. It indicates how well the content of the content image is preserved in the stylized image. Lower Content Loss values generally indicate better preservation of content.

#### 3. TV Loss:

- For both results:
  - Ranges from around 31419.77 to 32791.23.

TV Loss, or Total Variation Loss, encourages spatial smoothness in the generated image. It penalizes sharp transitions and encourages a more continuous appearance. The similarity in TV Loss values suggests that both sets of results maintain a similar level of spatial smoothness.

#### 4. Total Loss:

- For the reference results:
  - Ranges from around 740260.0 to 52247404.0.
- For your results:
  - Ranges from around 785646.44 to 64305100.0.

Total Loss is the sum of Style Loss, Content Loss, and TV Loss. It represents the overall optimization objective, balancing style fidelity, content preservation, and image smoothness. Lower Total Loss values indicate better overall stylization performance.

#### Comparison:

- Style Loss Variation:
  - The reference results show a wider range of Style Loss values, indicating more variation in style fidelity across iterations compared to your results.
- Content Loss Preservation:
  - Your results generally exhibit slightly higher Content Loss values, suggesting a potential variation in content preservation compared to the reference results.
- TV Loss and Total Loss:
  - Both sets of results maintain similar TV Loss and Total Loss values, indicating comparable levels of spatial smoothness and overall optimization performance.

Overall, the choice of hyperparameters, optimizer, and the inherent randomness in the optimization process can lead to variations in the stylized images and the associated losses. It's essential to experiment with different settings and evaluate the results based on the desired style transfer quality and content preservation.