NST Neural Style Transfer

January 12, 2022

[1]:
```
# Import Library
import torch
import torch.nn as nn
import torchvision
from torchvision import transforms, models
from PIL import Image
import numpy as np
import matplotlib.pyplot as plt
from torchvision.utils import save_image
import os
```

[5]:
```
# image path ---- only change this for your photo
content_img_path = 'blue-moon-lake.jpg'
style_img_path = 'style2.jpg'
```

[6]:
```
# Content Image
content_image = plt.imread(content_img_path)
plt.imshow(content_image)
print(content_image.shape)
```

```
(1200, 1920, 3)
```

[ ]:

[7]:
```
# Style Image
style_image = plt.imread(style_img_path)
plt.imshow(style_image)
print(style_image.shape)
```

```
(640, 1024, 3)
```

[8]:
```
# GPU setup
device = torch.device('cuda' if torch.cuda.is_available() else 'cpu')
```

[9]:
```
# get resized and transform image
def get_image(path, img_transform, size=(960, 660)):     # set size as your␣
 ↪requirement
    image = Image.open(path)
    image = image.resize(size, Image.LANCZOS)
#     image = image/255
    image = img_transform(image).unsqueeze(0)
    return image.to(device)

# get gram matrix to calculate style loss
def get_gram(m):
    """
    input: m is shape of (1, 3, h, w)
    return: m.mT
    """
    _, c, h, w = m.size()
    m = m.view(c, h*w)
    m = torch.mm(m, m.t())
    return m

# Denormalized image to plot and save
def denormalize(inp):
    inp = inp.numpy().transpose((1, 2, 0))
```

```
    mean = np.array([0.485, 0.456, 0.406])
    std = np.array([0.229, 0.224, 0.225])
    inp = std * inp + mean
    inp = np.clip(inp, 0, 1)
    return inp
```

[10]:
```
# Setup NST CNN architecture----> used VGG16 pre-trained model here
class FeatureExtractor(nn.Module):
    def __init__(self):
        super(FeatureExtractor, self).__init__()
        self.selected_layers = [3, 8, 15, 22]
        self.vgg = models.vgg16(pretrained=True).features

    def forward(self, x):
        layer_feats = []
        for i, layer in self.vgg._modules.items():
            x = layer(x)
            if int(i) in self.selected_layers:
                layer_feats.append(x)
        return layer_feats
```

[11]:
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# set parameter
img_transform = transforms.Compose([transforms.ToTensor(),
                                    transforms.Normalize(mean = [0.485, 0.456, 0.
↪406],
                                                         std = [0.229, 0.224, 0.
↪225])])

content_img = get_image(content_img_path, img_transform)
style_img = get_image(style_img_path, img_transform)
generate_img = content_img.clone()
generate_img.requires_grad = True


# save photo
sample_dir = 'results_NST'
if not os.path.exists(sample_dir):
    os.makedirs(sample_dir)
```

[12]:
```
# optimizer
optimizer = torch.optim.Adam([generate_img], lr=0.2, betas=[0.9, 0.999])

#encoder
encoder = FeatureExtractor().to(device)
for p in encoder.parameters():
    p.requires_grad = False
```

[13]:
```
# Trainig
style_weight = 1000
content_weight = 10000
for epoch in range(1001):
    content_features = encoder(content_img)
    style_features = encoder(style_img)
    generated_feature = encoder(generate_img)
    # Calculate content loss
    content_loss = torch.mean((content_features[-1] - generated_feature[-1])**2)

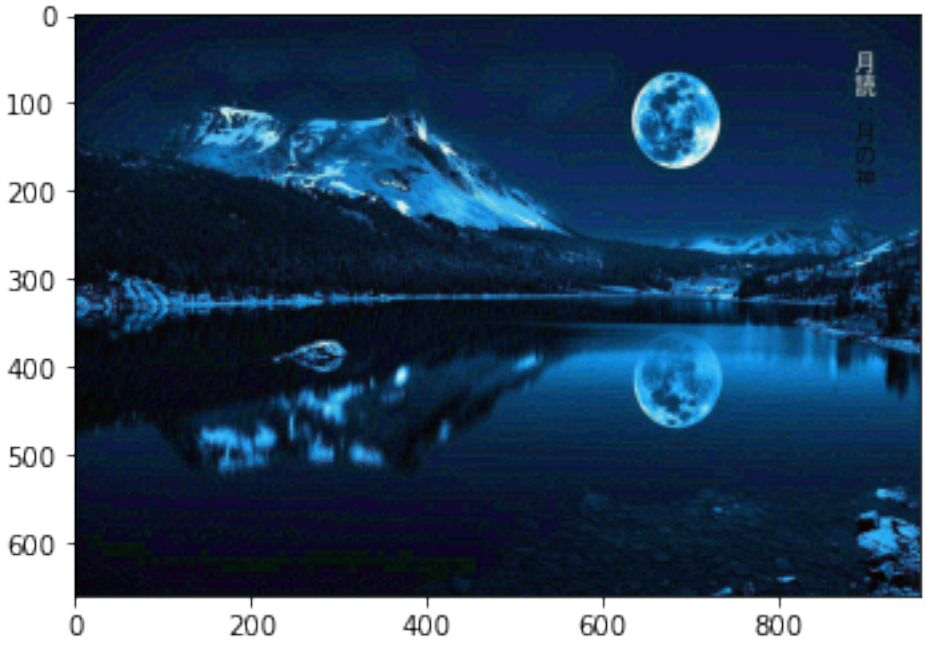
    style_loss = 0
    for gf, sf in zip(generated_feature, style_features):
        _, c, h, w = gf.size()
        gram_gf = get_gram(gf)
        gram_sf = get_gram(sf)
        # calculate style loss
        style_loss += torch.mean((gram_gf - gram_sf)**2) / (c * h * w)

    loss = content_weight * content_loss + style_weight * style_loss  # Total␣
 ↪loss

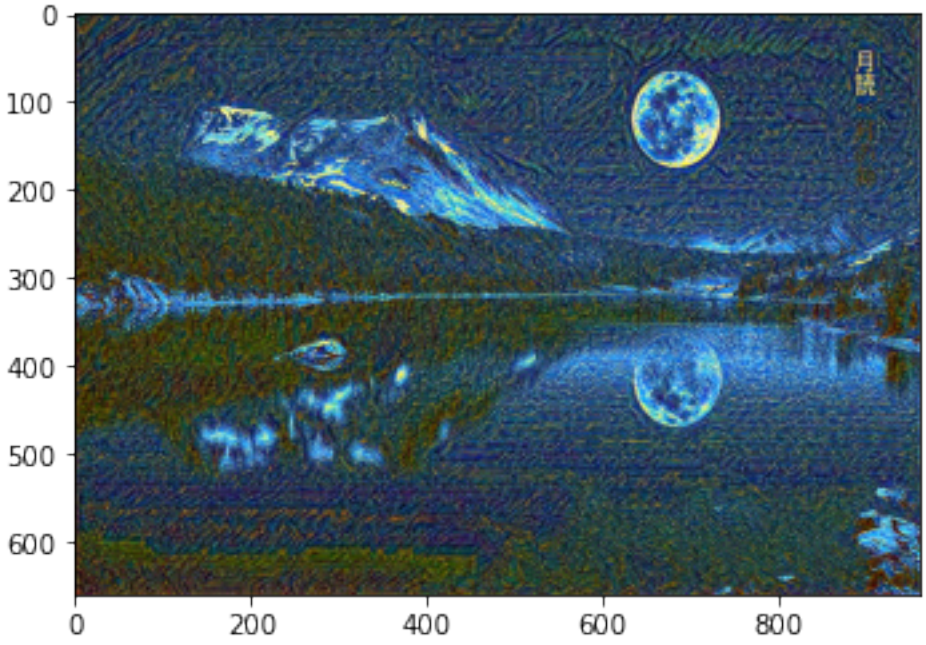
    optimizer.zero_grad()
    loss.backward()
    optimizer.step()

    if epoch % 50 == 0:  # record log
        print('Epoch: [{}]\t Content Loss: {:.4f}\t Style Loss: {:.4f}\t'.
 ↪format(epoch, content_loss.item(), style_loss.item()))
        inp = generate_img.detach().cpu().squeeze(0)
        inp = denormalize(inp)
        # save image
        plt.imsave('results_NST/nst7_' + str(epoch) + '.png', inp)
#         save_image(inp, 'results_NST/nst_' + str(epoch) + '.png')
        plt.imshow(inp)
        plt.show()
```

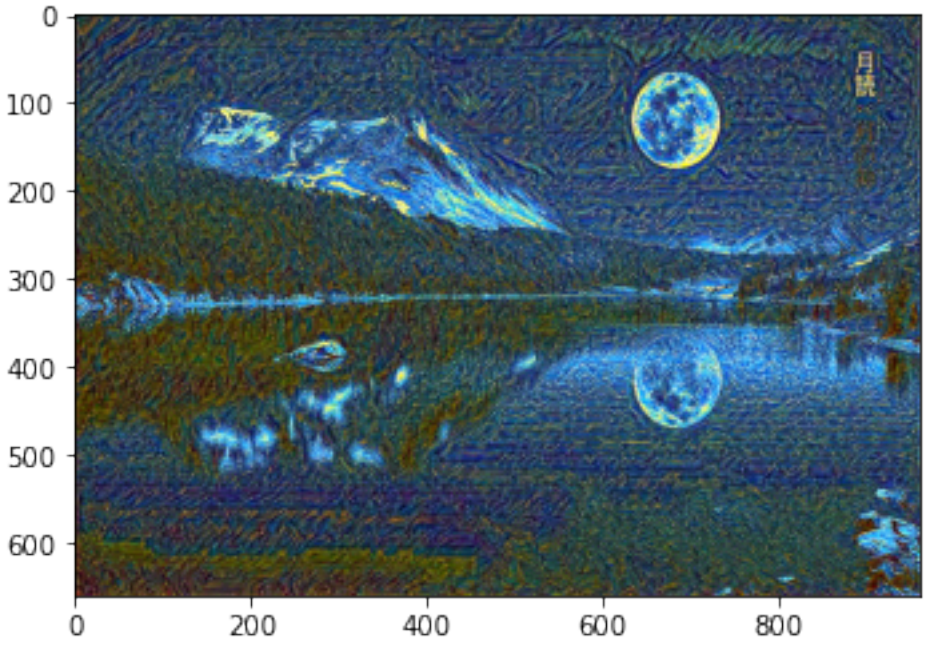
```
Epoch: [0]       Content Loss: 0.0000    Style Loss: 84226.1328
```



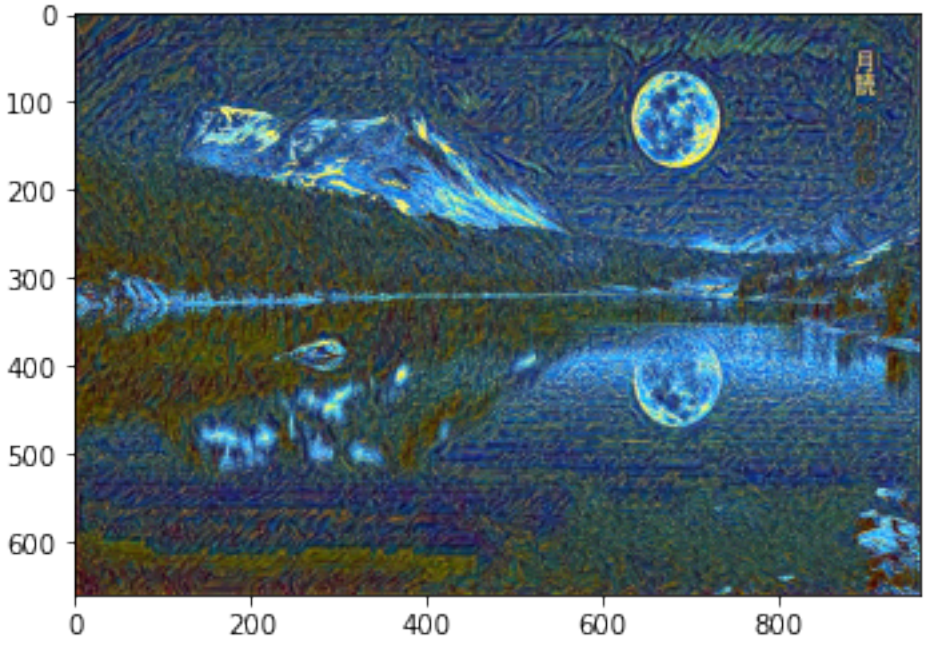
Epoch: [50] Content Loss: 1.3925 Style Loss: 287.4901



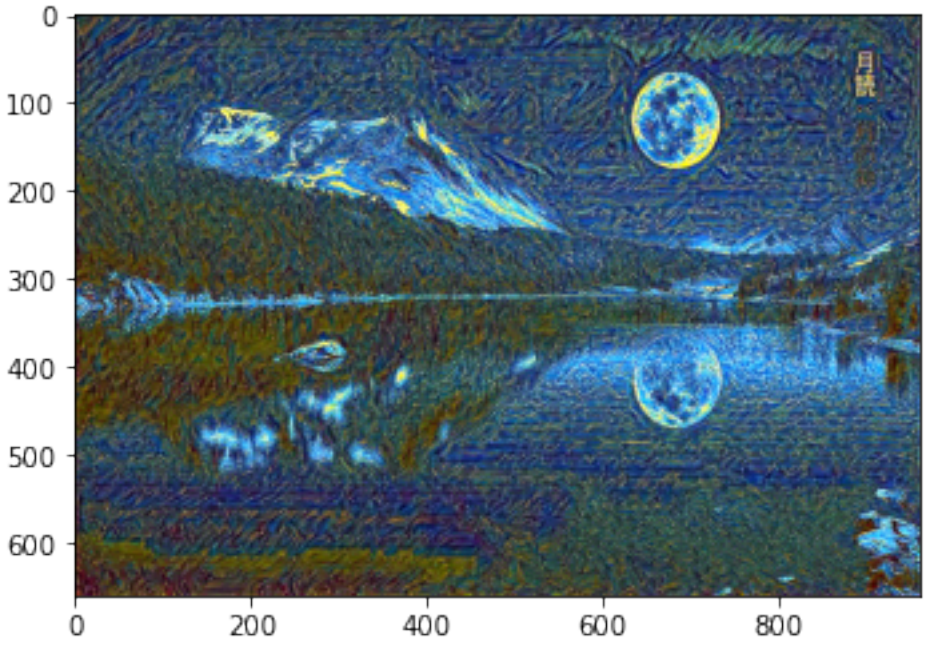
Epoch: [100] Content Loss: 1.0565 Style Loss: 112.7182



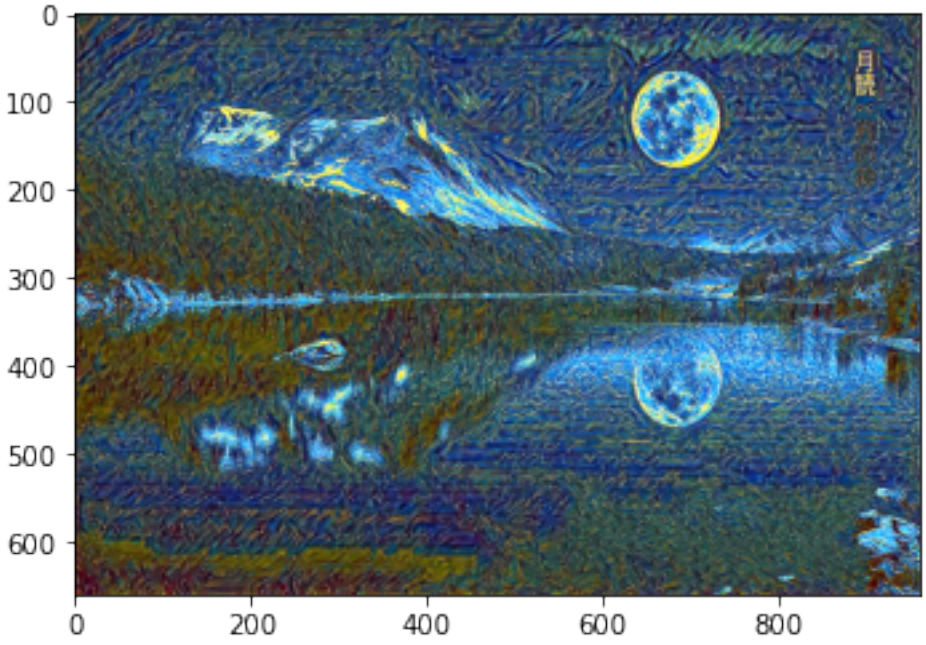
Epoch: [150] Content Loss: 0.9153 Style Loss: 64.7766



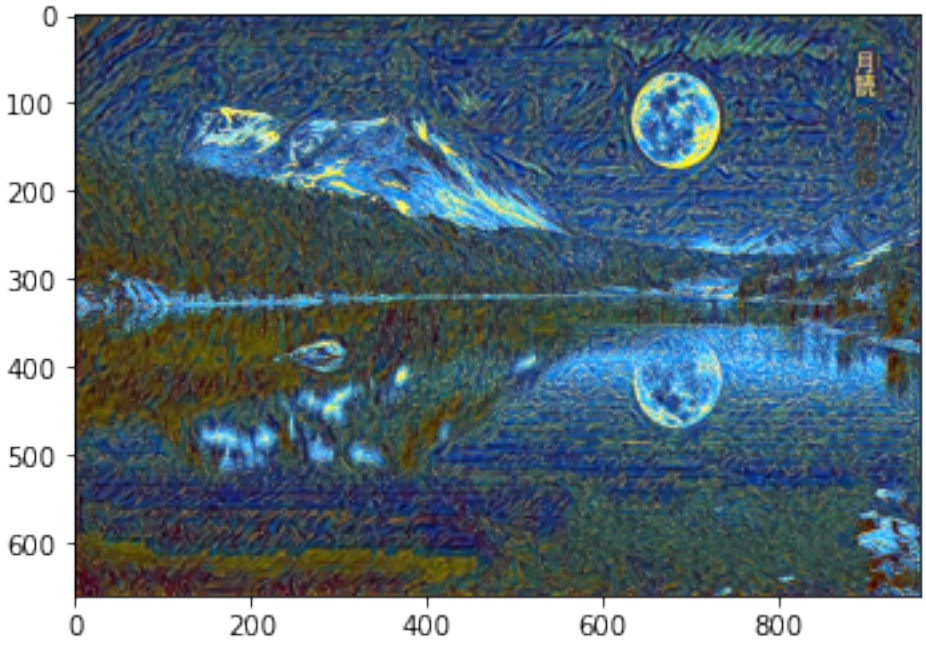
Epoch: [200] Content Loss: 0.8225 Style Loss: 43.2683



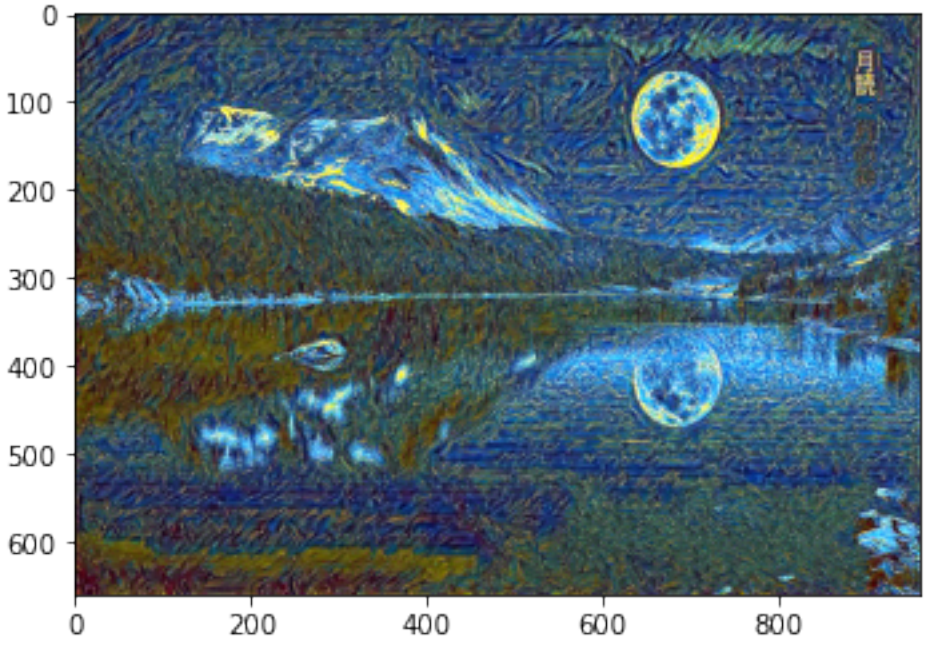
Epoch: [250] Content Loss: 0.7527 Style Loss: 31.6804



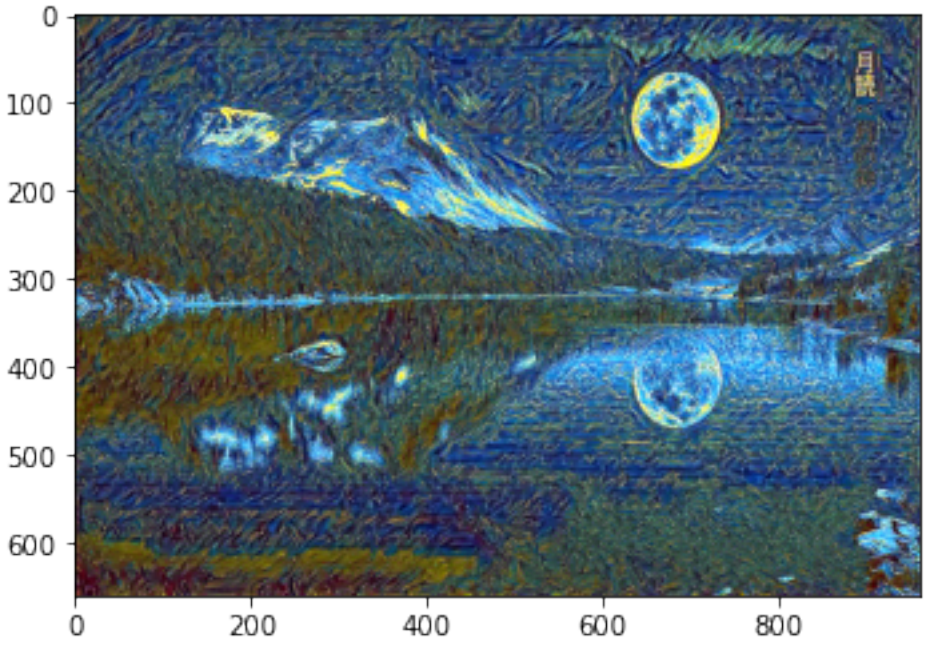
Epoch: [300] Content Loss: 0.6970 Style Loss: 24.6751



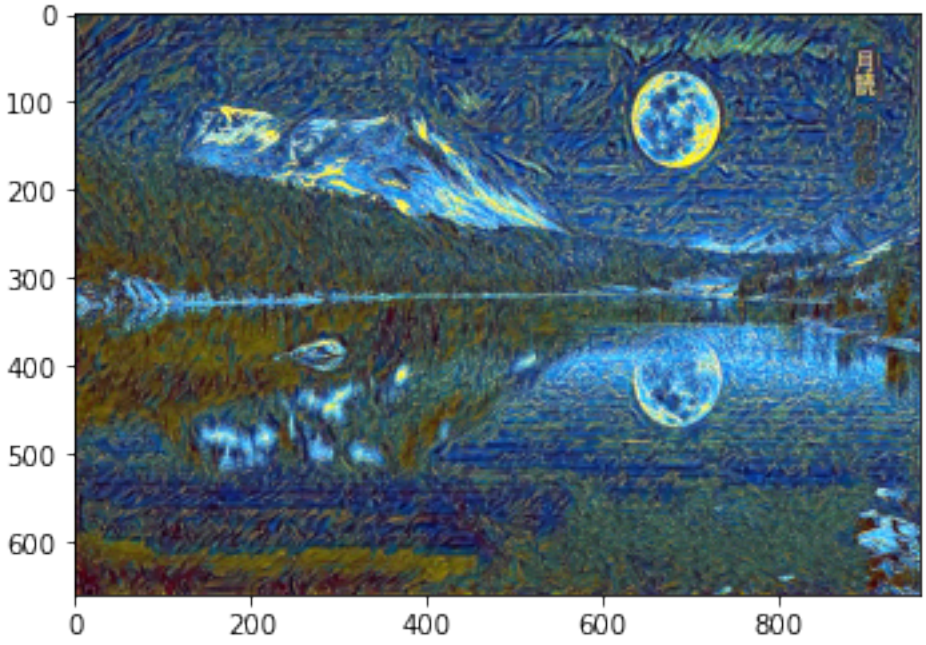
Epoch: [350] Content Loss: 0.6525 Style Loss: 20.0705



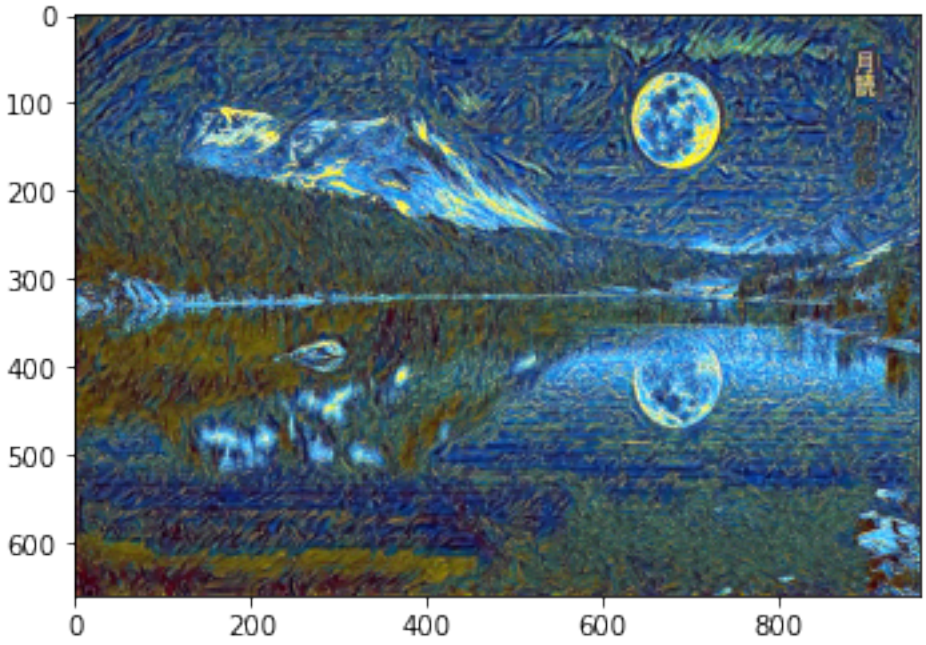
Epoch: [400] Content Loss: 0.6155 Style Loss: 16.8512



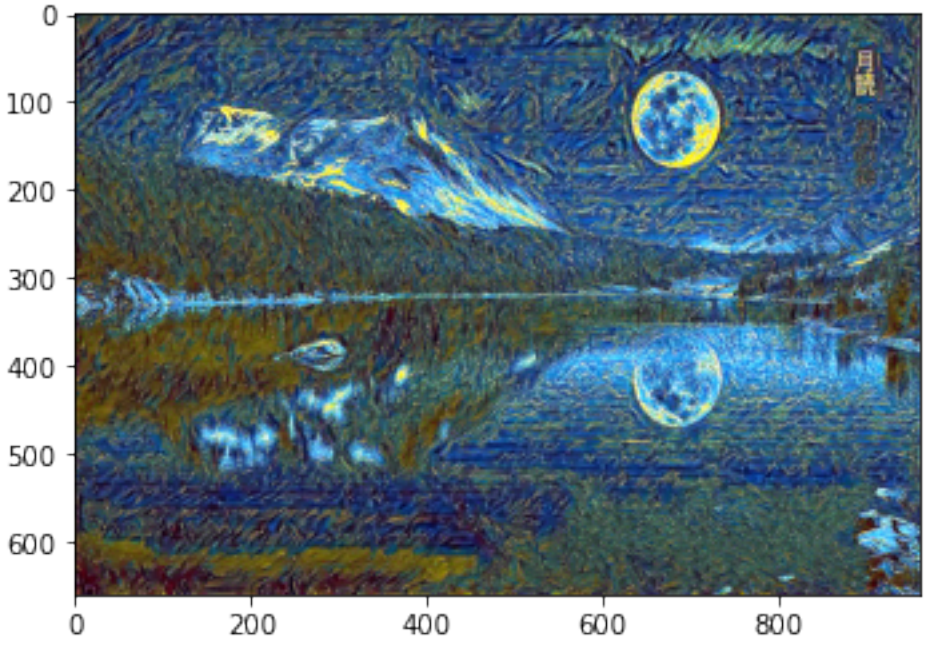
Epoch: [450] Content Loss: 0.5841 Style Loss: 14.4824



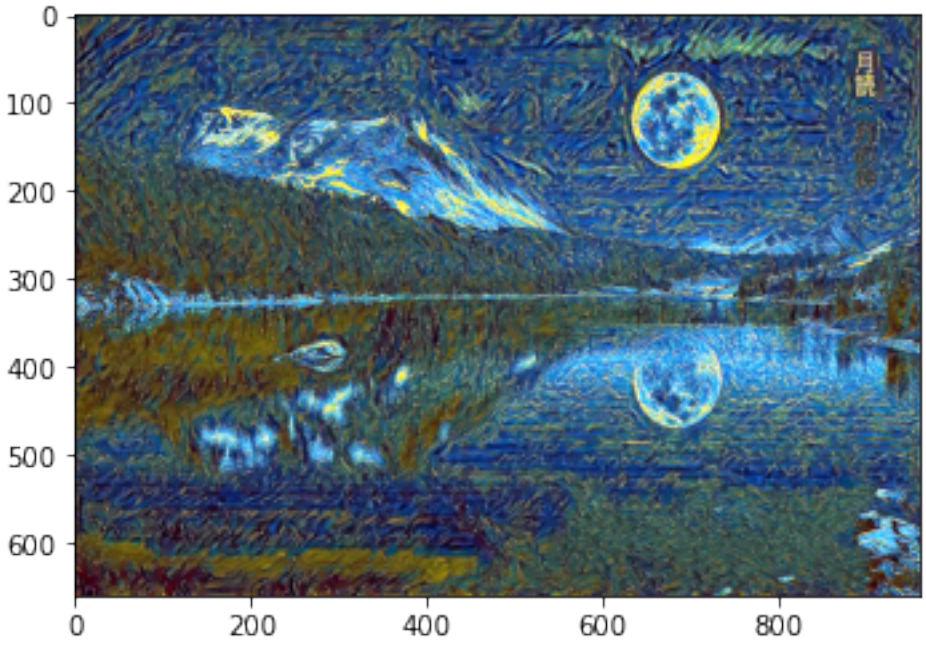
Epoch: [500] Content Loss: 0.5567 Style Loss: 12.6706



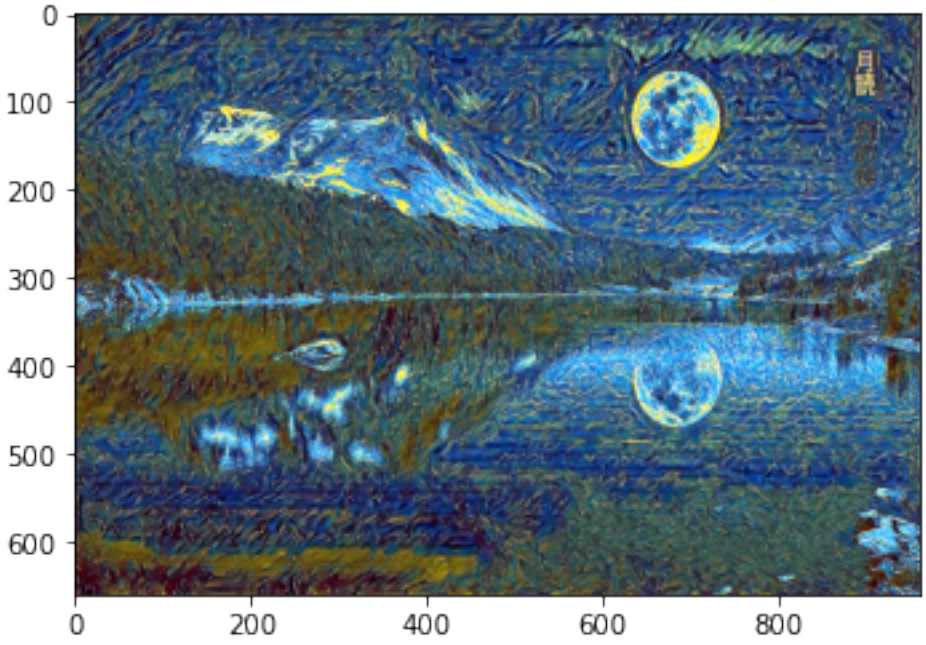

```
Epoch: [550]     Content Loss: 0.5328    Style Loss: 11.2426
```



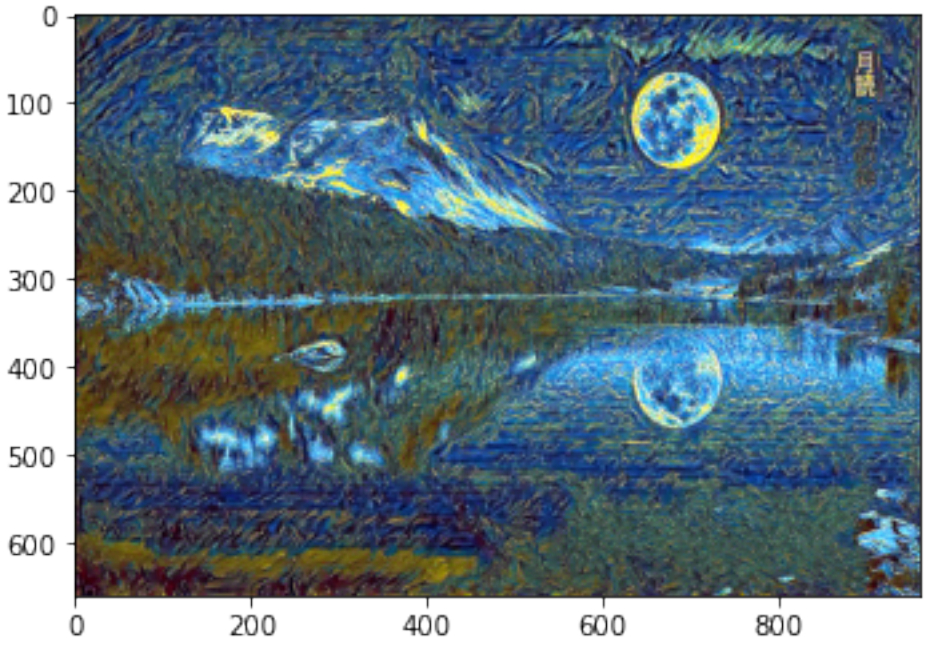

```
Epoch: [600]     Content Loss: 0.5117    Style Loss: 10.0892
```



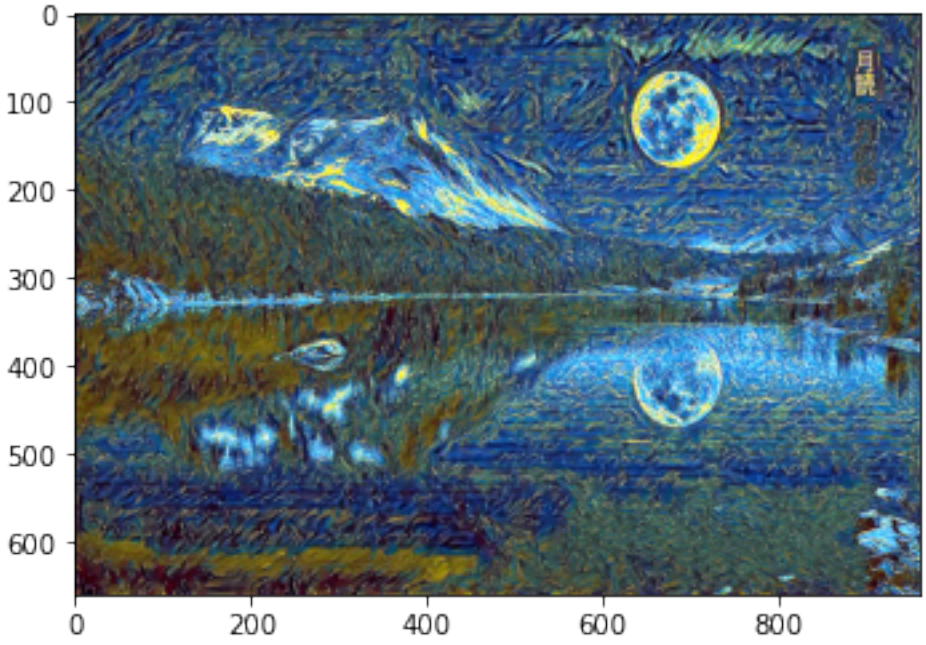
Epoch: [650] Content Loss: 0.4948 Style Loss: 11.0803



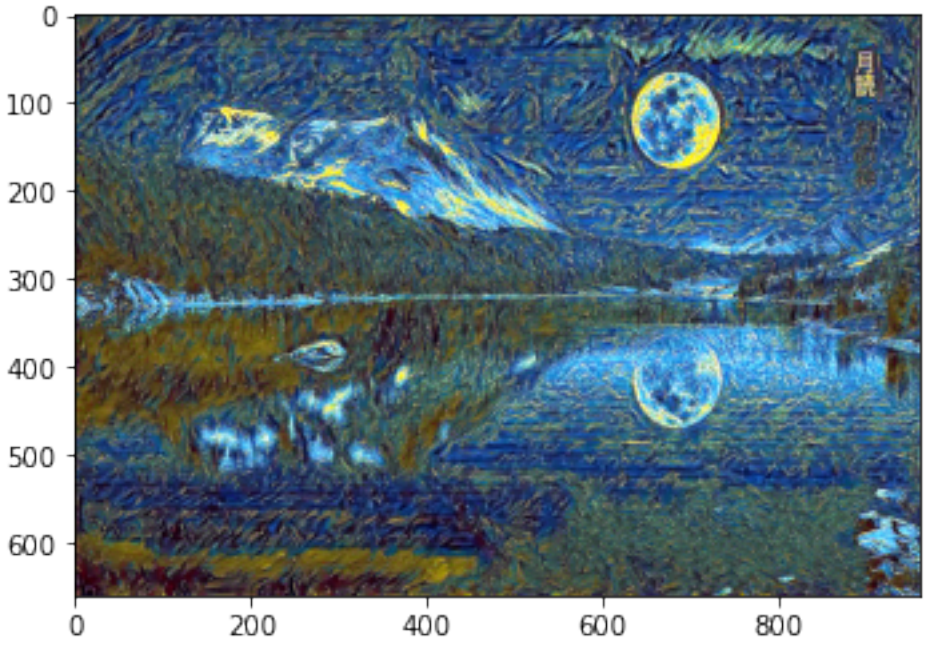
Epoch: [700] Content Loss: 0.4764 Style Loss: 8.5679



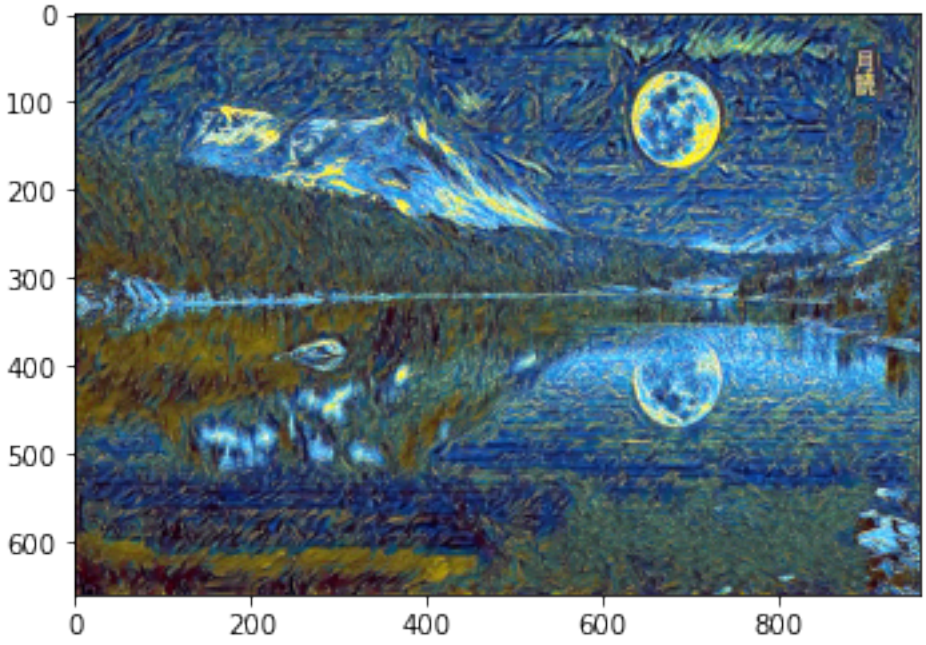

```
Epoch: [750]     Content Loss: 0.4630    Style Loss: 8.2269
```



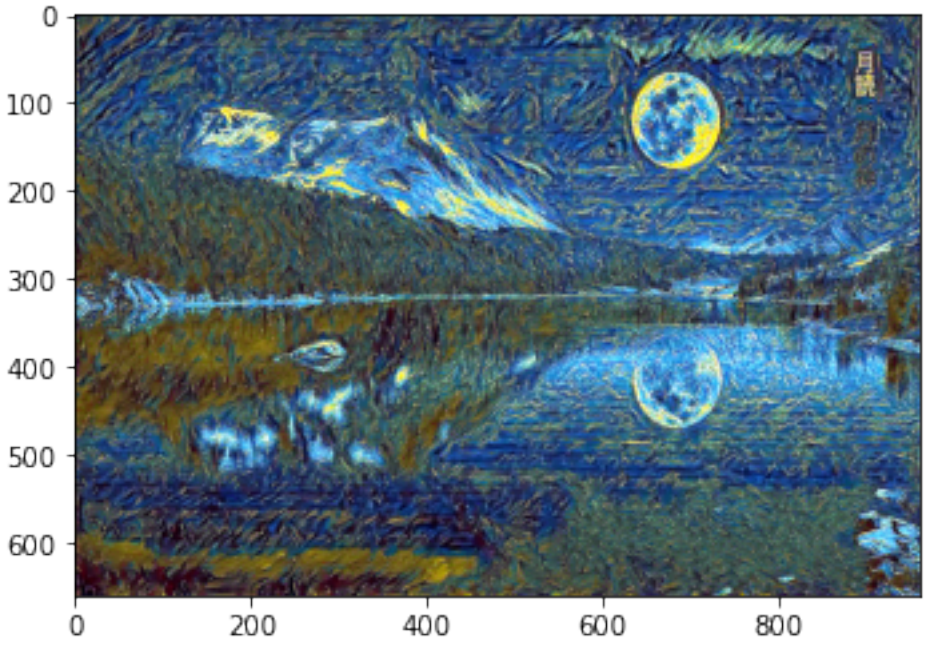

```
Epoch: [800]     Content Loss: 0.4528    Style Loss: 7.8429
```



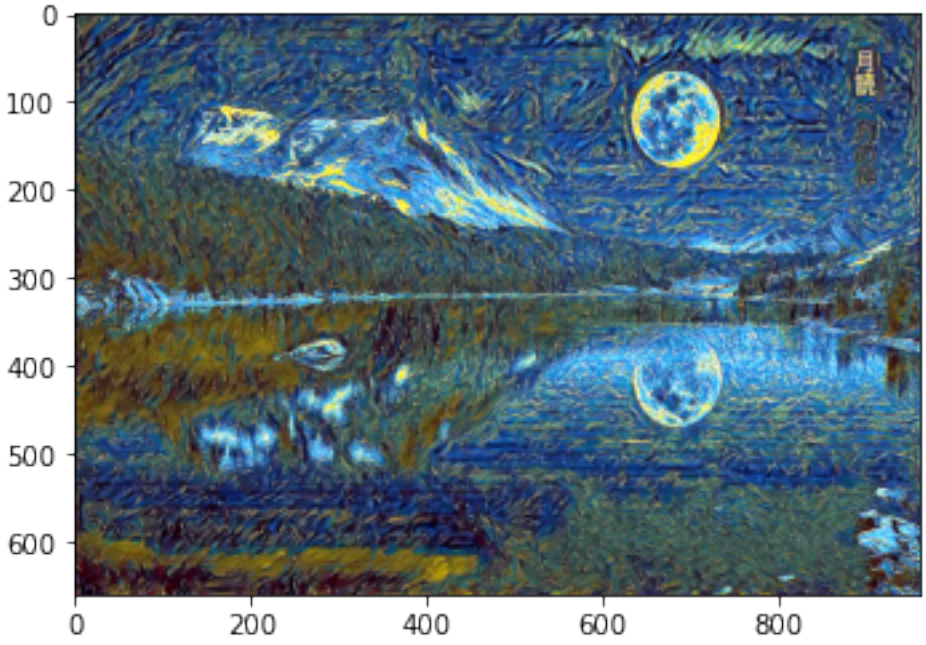
Epoch: [850] Content Loss: 0.4386 Style Loss: 7.4788



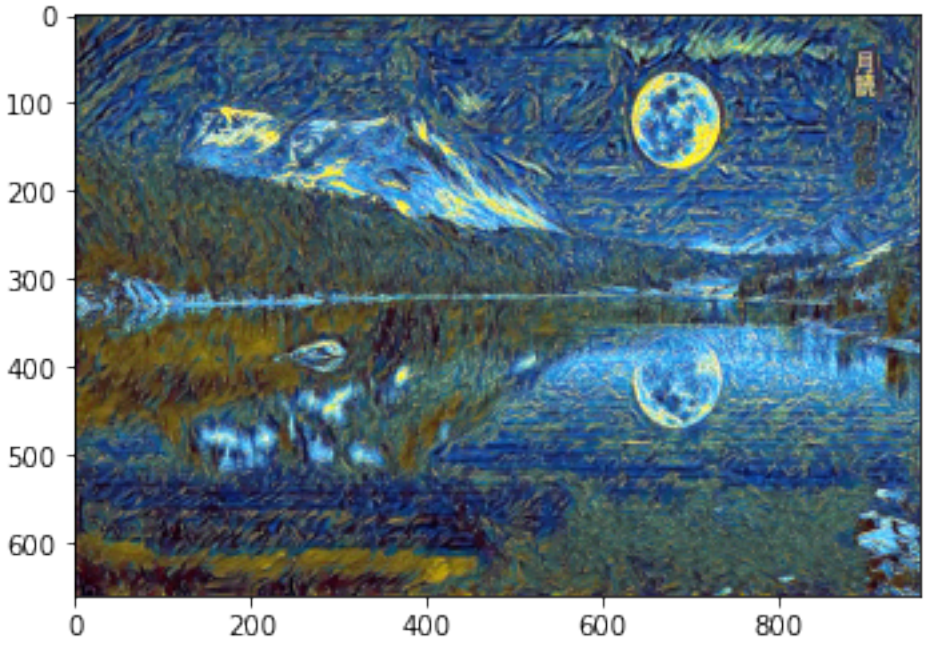
Epoch: [900] Content Loss: 0.4309 Style Loss: 7.4680



Epoch: [950] Content Loss: 0.4227 Style Loss: 6.1279

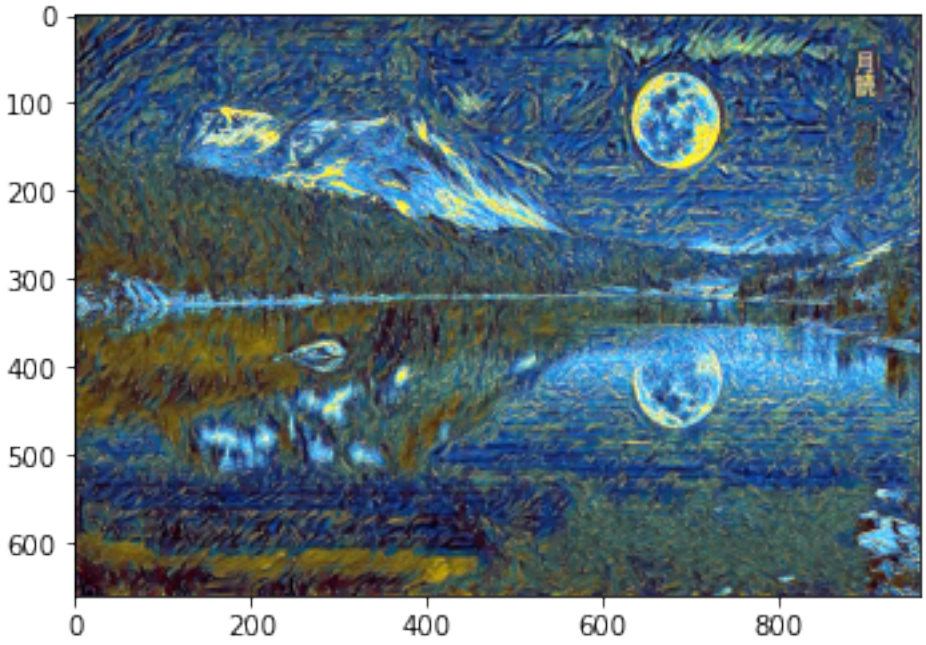


Epoch: [1000] Content Loss: 0.5200 Style Loss: 23.0717



[14]:
```
# View Generate image
inp = generate_img.detach().cpu().squeeze(0)
inp = denormalize(inp)
plt.imshow(inp)
```

[14]: <matplotlib.image.AxesImage at 0x7fa5204ed100>



[ ]: