pytorch_nn

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https://github.com/leongatys/PytorchNeuralStyleTransfer

```
In [1]: %pylab inline
        import time
        import os
        import torch
        from torch.autograd import Variable as V
        import torch.nn as nn
        import torch.nn.functional as F
        import torchvision.models as models
        from torch import optim
        #import torchvision
        from torchvision import transforms
        from PIL import Image
        #from collections import OrderedDict

        t0 = time.clock()
```

```
Populating the interactive namespace from numpy and matplotlib
```

1 Model

```
In [2]: ## We use the pretrained model formation constructed by Gatys L.
        class VGG(nn.Module):
            def __init__(self, pool="max"):#
                super(VGG, self).__init__()
                ## vgg modules
                self.conv1_1 = nn.Conv2d(3, 64, kernel_size=3, padding=1)
                self.conv1_2 = nn.Conv2d(64, 64, kernel_size=3, padding=1)
                self.conv2_1 = nn.Conv2d(64, 128, kernel_size=3, padding=1)
                self.conv2_2 = nn.Conv2d(128, 128, kernel_size=3, padding=1)
                self.conv3_1 = nn.Conv2d(128, 256, kernel_size=3, padding=1)
                self.conv3_2 = nn.Conv2d(256, 256, kernel_size=3, padding=1)
                self.conv3_3 = nn.Conv2d(256, 256, kernel_size=3, padding=1)
                self.conv3_4 = nn.Conv2d(256, 256, kernel_size=3, padding=1)
                self.conv4_1 = nn.Conv2d(256, 512, kernel_size=3, padding=1)
        self.conv4_2 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        self.conv4_3 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        self.conv4_4 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        self.conv5_1 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        self.conv5_2 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        self.conv5_3 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        self.conv5_4 = nn.Conv2d(512, 512, kernel_size=3, padding=1)
        if pool == 'max':
            self.pool1 = nn.MaxPool2d(kernel_size=2, stride=2)
            self.pool2 = nn.MaxPool2d(kernel_size=2, stride=2)
            self.pool3 = nn.MaxPool2d(kernel_size=2, stride=2)
            self.pool4 = nn.MaxPool2d(kernel_size=2, stride=2)
            self.pool5 = nn.MaxPool2d(kernel_size=2, stride=2)
        elif pool == 'avg':
            self.pool1 = nn.AvgPool2d(kernel_size=2, stride=2)
            self.pool2 = nn.AvgPool2d(kernel_size=2, stride=2)
            self.pool3 = nn.AvgPool2d(kernel_size=2, stride=2)
            self.pool4 = nn.AvgPool2d(kernel_size=2, stride=2)
            self.pool5 = nn.AvgPool2d(kernel_size=2, stride=2)

    def forward(self, x, out_keys):
        out = {}
        out['r11'] = F.relu(self.conv1_1(x))
        out['r12'] = F.relu(self.conv1_2(out['r11']))
        out['p1'] = self.pool1(out['r12'])
        out['r21'] = F.relu(self.conv2_1(out['p1']))
        out['r22'] = F.relu(self.conv2_2(out['r21']))
        out['p2'] = self.pool2(out['r22'])
        out['r31'] = F.relu(self.conv3_1(out['p2']))
        out['r32'] = F.relu(self.conv3_2(out['r31']))
        out['r33'] = F.relu(self.conv3_3(out['r32']))
        out['r34'] = F.relu(self.conv3_4(out['r33']))
        out['p3'] = self.pool3(out['r34'])
        out['r41'] = F.relu(self.conv4_1(out['p3']))
        out['r42'] = F.relu(self.conv4_2(out['r41']))
        out['r43'] = F.relu(self.conv4_3(out['r42']))
        out['r44'] = F.relu(self.conv4_4(out['r43']))
        out['p4'] = self.pool4(out['r44'])
        out['r51'] = F.relu(self.conv5_1(out['p4']))
        out['r52'] = F.relu(self.conv5_2(out['r51']))
        out['r53'] = F.relu(self.conv5_3(out['r52']))
        out['r54'] = F.relu(self.conv5_4(out['r53']))
        out['p5'] = self.pool5(out['r54'])
        return [out[key] for key in out_keys]

## Load model
def model_loader(model_name):
    model = VGG()
```

```
            model.load_state_dict(torch.load(model_name))
            for param in model.parameters():
                param.requires_grad = False
            if torch.cuda.is_available():
                model.cuda()
            return model
```

2 Image Processing

```
In [3]: ## We use the image preprocessing, postprocessing constructed by Gatys L.
        def preprocess(img_size,img):
            prep = transforms.Compose([transforms.Resize(img_size),
                                       transforms.ToTensor(),
                                       transforms.Lambda(lambda x: x[torch.LongTensor([2,1,0])]), #
                                       transforms.Normalize(mean=[0.406, 0.456, 0.485], ##subtract
                                                            std=[1,1,1]),
                                       transforms.Lambda(lambda x: x.mul_(255))])
            return prep(img)

        def postprocess(tensor):
            post1 = transforms.Compose([transforms.Lambda(lambda x: x.mul_(1./255)),
                                       transforms.Normalize(mean=[-0.406, -0.456, -0.485], ##add i
                                                            std=[1,1,1]),
                                       transforms.Lambda(lambda x: x[torch.LongTensor([2,1,0])])])
            post2=transforms.Compose([transforms.ToPILImage()])
            t = post1(tensor).cpu()
            t[t>1] = 1
            t[t<0] = 0
            img = post2(t)
            return img

        def image_input(image_name):
            img_size=512 ##can be revised
            image=Image.open(image_name)
            image=preprocess(img_size,image)
            image=V(image).unsqueeze(0)
            if torch.cuda.is_available():
                image=image.cuda()
            return image
```

3 Loss Function

```
In [4]: ## Gram Matrix and Loss
        def gram_matrix(input):
            ## a=batch size(=1)
            a, c, h, w = input.size()
            ## unrolled the matrix
```

```
    gram = input.view(a * c, h * w)
    ## compute the gram product
    G = torch.mm(gram, gram.transpose(0,1))
    ## the gram matrix is normalized by dividing by numbers of elements in each channe
    G = G.div_(h*w)
    return G

class Stylell(nn.Module):
    def forward(self, input, target):
        out= torch.mean(torch.pow((gram_matrix(input)-gram_matrix(target)),2))
        if torch.cuda.is_available():
            out=out.cuda()
        return out

def content_matrix(input):
    a, c, h, w = input.size()
    C = input.view(a * c, h * w)
    return C

class Contentll(nn.Module):
    def forward(self, input, target):
        out= torch.mean(torch.pow((content_matrix(input)-content_matrix(target)),2))
        if torch.cuda.is_available():
            out=out.cuda()
        return out

def StyleLoss(layers,weights,style_img,generate_img,model):
    style_model=model(style_img,layers)
    style_targets = [i.detach() for i in style_model]
    generate_model=model(generate_img,layers)
    sloss=0
    for i,j in enumerate(generate_model):
        if torch.cuda.is_available():
            result=(weights[i]*Stylell()(j,style_targets[i]).cuda())
        else:
            result=(weights[i]*Stylell()(j,style_targets[i]))
        sloss=sloss+result
    return sloss

def ContentLoss(layers,weights,content_img,generate_img,model):
    content_model=model(content_img,layers)
    content_targets = [i.detach() for i in content_model]
    generate_model=model(generate_img,layers)
    closs=0
    for i,j in enumerate(generate_model):
        if torch.cuda.is_available():
            result=(weights[i]*Contentll()(j,content_targets[i]).cuda())
        else:
```

```
                    result=(weights[i]*Contentll()(j,content_targets[i]))
                closs=closs+result
            return closs


        def total_loss(loss_s,loss_c,hp):
            ## hp=hyperparameter list [hp for loss_s, hp for loss_c]
            loss=loss_s*hp[0]+loss_c*hp[1]
            return loss
```

4 Model Iteration Run

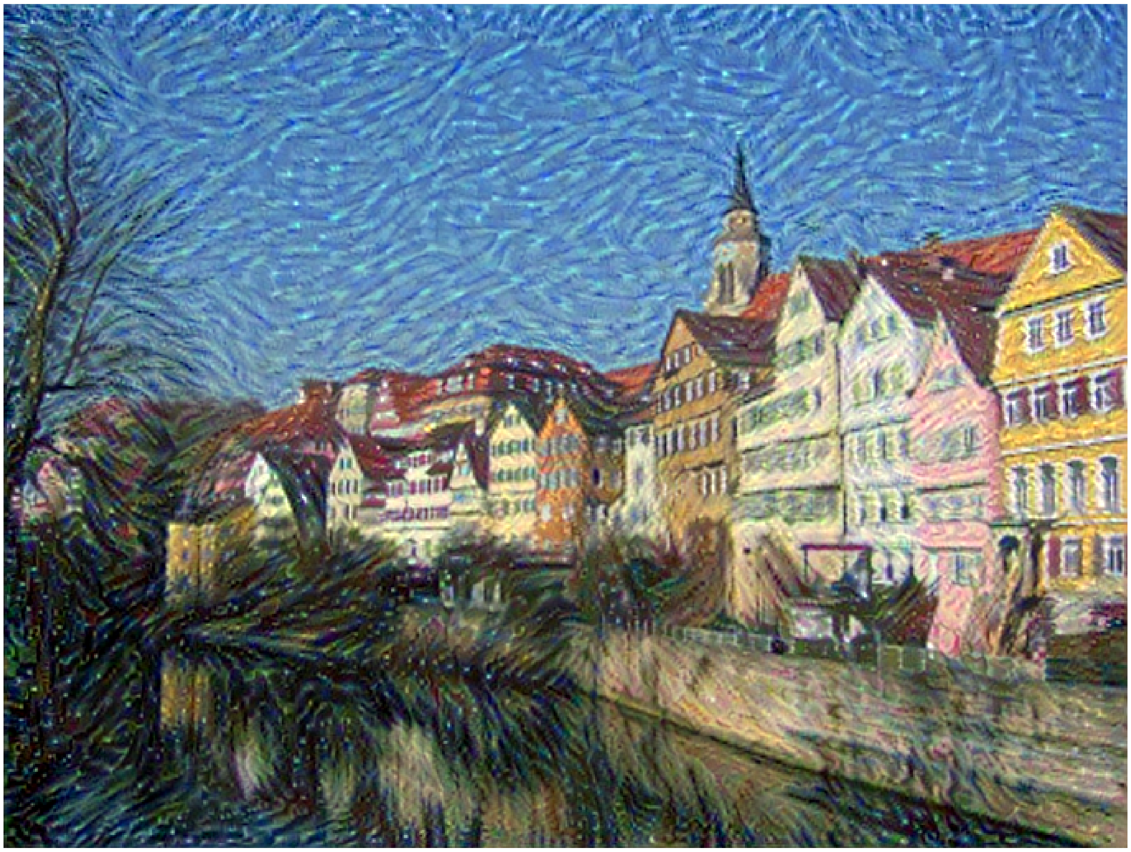
```
In [5]: def iteration_run(N,show_iter,style_img,content_img,model):

            ##random init
            ##generate = V(torch.randn(content_img.size()).type_as(content_img.data), requires_
            generate = V(content_img.data.clone(), requires_grad=True)
            if torch.cuda.is_available():
                generate=generate.cuda()

            style_layers = ['r11','r21','r31','r41', 'r51']
            content_layers = ['r42']

            style_weights = [1e3/n**2 for n in [64,128,256,512,512]]
            content_weights = [1]

            hyper=[1,1]
            current=[0]
            optimizer = optim.LBFGS([generate])

            while current[0] <= N:
                def optima():
                    optimizer.zero_grad()
                    loss_s=StyleLoss(style_layers,style_weights,style_img,generate,model)
                    loss_c=ContentLoss(content_layers,content_weights,content_img,generate,mode
                    loss=total_loss(loss_s,loss_c,hyper)
                    loss.backward()
                    current[0]+=1
                    #print loss
                    if current[0]%show_iter == (show_iter-1):
                        print('Iteration: %d, loss: %f'%(current[0]+1, loss.data[0]))
                    return loss
                optimizer.step(optima)
            return generate
```

5 Result

```
In [6]: #Run style transfer
        vgg=model_loader('vgg_conv.pth')
        style=image_input("vango.jpg")
        content=image_input("tubingen.jpg")

        max_iter = 5
        show_iter= 5

        generate=iteration_run(max_iter,show_iter,style,content,vgg)
```

```
/home/shulincao/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:34: UserWarning: i


Iteration: 5, loss: 342729248.000000
Iteration: 10, loss: 55196432.000000
Iteration: 15, loss: 17092684.000000
Iteration: 20, loss: 8933261.000000
```

```
In [8]: ##Display result
        g_img = postprocess(generate.data[0].squeeze())
        display(g_img)
        print(time.clock() - t0, "seconds process time")
```



```
8.689625999999999 seconds process time
```