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import tensorflow as tf
import numpy as np
import PIL.Image
import time
import matplotlib.pyplot as plt
from IPython.display import clear_output

CONTENT_PATH = 'content.jpg'
STYLE_PATH = 'style.jpg'

def load_img(path_to_img):
    max_dim = 512
    img = tf.io.read_file(path_to_img)
    img = tf.image.decode_image(img, channels=3)
    img = tf.image.convert_image_dtype(img, tf.float32)

    shape = tf.cast(tf.shape(img)[:-1], tf.float32)
    long_dim = max(shape)
    scale = max_dim / long_dim

    new_shape = tf.cast(shape * scale, tf.int32)
    img = tf.image.resize(img, new_shape)
    img = img[tf.newaxis, :]
    return img

def tensor_to_image(tensor):
    tensor = tensor * 255
    tensor = np.array(tensor, dtype=np.uint8)
    if np.ndim(tensor) > 3:
        assert tensor.shape[0] == 1
        tensor = tensor[0]
    return PIL.Image.fromarray(tensor)

content_layers = ['block5_conv2']
style_layers = ['block1_conv1', 'block2_conv1', 'block3_conv1', 'block4_conv1', 'block5_conv1']

def vgg_layers(layer_names):
    """ Loads VGG19 model and returns a model that outputs specific intermediate layers. """
    vgg = tf.keras.applications.VGG19(include_top=False, weights='imagenet')
    vgg.trainable = False
    outputs = [vgg.get_layer(name).output for name in layer_names]
    model = tf.keras.Model([vgg.input], outputs)
    return model

def gram_matrix(input_tensor):
    """ Calculates the Gram Matrix to capture style correlations. """
    result = tf.linalg.einsum('bijc,bijd->bcd', input_tensor, input_tensor)
    input_shape = tf.shape(input_tensor)
    num_locations = tf.cast(input_shape[1]*input_shape[2], tf.float32)
    return result/(num_locations)

class StyleContentModel(tf.keras.models.Model):
    def __init__(self, style_layers, content_layers):
        super(StyleContentModel, self).__init__()
        self.vgg = vgg_layers(style_layers + content_layers)
        self.style_layers = style_layers
        self.content_layers = content_layers
        self.num_style_layers = len(style_layers)
        self.vgg.trainable = False

    def call(self, inputs):
        """ Preprocesses input and extracts style and content features. """
        inputs = inputs * 255.0
        preprocessed_input = tf.keras.applications.vgg19.preprocess_input(inputs)
        outputs = self.vgg(preprocessed_input)

        style_outputs, content_outputs = (outputs[:self.num_style_layers],
                                          outputs[self.num_style_layers:])

        style_outputs = [gram_matrix(style_output) for style_output in style_outputs]

        content_dict = {content_name: value for content_name, value in zip(self.content_layers, content_outputs)}
        style_dict = {style_name: value for style_name, value in zip(self.style_layers, style_outputs)}

        return {'content': content_dict, 'style': style_dict}

def style_content_loss(outputs, style_targets, content_targets, style_weight, content_weight):
    style_outputs = outputs['style']
    content_outputs = outputs['content']

    style_loss = tf.add_n([tf.reduce_mean((style_outputs[name]-style_targets[name])**2)
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                            for name in style_outputs.keys()])
    style_loss *= style_weight / len(style_layers)

    content_loss = tf.add_n([tf.reduce_mean((content_outputs[name]-content_targets[name])**2)
                             for name in content_outputs.keys()])
    content_loss *= content_weight / len(content_layers)

    return style_loss + content_loss
try:
    content_image = load_img(CONTENT_PATH)
    style_image = load_img(STYLE_PATH)
except:
    print("Files not found. Downloading samples to demonstrate...")
    CONTENT_PATH = tf.keras.utils.get_file('YellowLabrador.jpg', 'https://storage.googleapis.com/download.tensorflow.org/exa
    STYLE_PATH = tf.keras.utils.get_file('kandinsky.jpg', 'https://storage.googleapis.com/download.tensorflow.org/example_im
    content_image = load_img(CONTENT_PATH)
    style_image = load_img(STYLE_PATH)

extractor = StyleContentModel(style_layers, content_layers)
style_targets = extractor(style_image)['style']
content_targets = extractor(content_image)['content']

image = tf.Variable(content_image)
opt = tf.optimizers.Adam(learning_rate=0.02, beta_1=0.99, epsilon=1e-1)

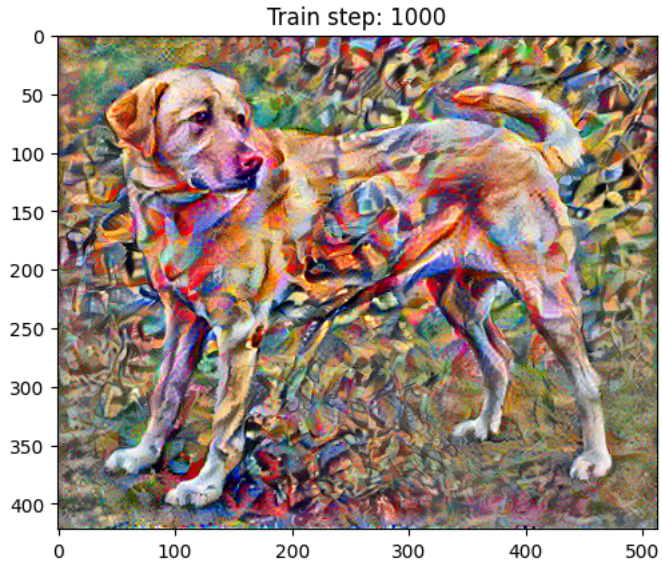
@tf.function()
def train_step(image, style_weight=1e-2, content_weight=1e4):
    with tf.GradientTape() as tape:
        outputs = extractor(image)
        loss = style_content_loss(outputs, style_targets, content_targets, style_weight, content_weight)

    grad = tape.gradient(loss, image)
    opt.apply_gradients([(grad, image)])
    image.assign(tf.clip_by_value(image, 0.0, 1.0))

start = time.time()
epochs = 10
steps_per_epoch = 100

step = 0
for n in range(epochs):
    for m in range(steps_per_epoch):
        step += 1
        train_step(image)
    clear_output(wait=True)
    plt.imshow(tensor_to_image(image))
    plt.title(f"Train step: {step}")
    plt.show()

print(f"Total time: {time.time()-start:.1f} seconds")
tensor_to_image(image).save('stylized_output.jpg')
```

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Total time: 78.6 seconds
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Start coding or generate with AI.