Assignment12 Sutow Brett

July 21, 2021

[5]:

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#Assignmet 12#
import tensorflow.compat.v1.keras.backend as K
import tensorflow as tf
tf.compat.v1.disable_eager_execution()
from keras.datasets import mnist
import keras
from keras import layers
from keras import backend as K
from keras.models import Model
import numpy as np

img_shape = (28, 28, 1)
batch_size = 16
latent_dim = 2

input_img = keras.Input(shape=img_shape)

x = layers.Conv2D(32, 3,
                  padding='same', activation='relu')(input_img)
x = layers.Conv2D(64, 3,
                  padding='same', activation='relu',
                  strides=(2, 2))(x)
x = layers.Conv2D(64, 3,
                  padding='same', activation='relu')(x)
x = layers.Conv2D(64, 3,
                  padding='same', activation='relu')(x)
shape_before_flattening = K.int_shape(x)

x = layers.Flatten()(x)
x = layers.Dense(32, activation='relu')(x)

z_mean = layers.Dense(latent_dim)(x)
z_log_var = layers.Dense(latent_dim)(x)
def sampling(args):
    z_mean, z_log_var = args
    epsilon = K.random_normal(shape=(K.shape(z_mean)[0], latent_dim),
                              mean=0., stddev=1.)
    return z_mean + K.exp(z_log_var) * epsilon

z = layers.Lambda(sampling)([z_mean, z_log_var])

decoder_input = layers.Input(K.int_shape(z)[1:])

x = layers.Dense(np.prod(shape_before_flattening[1:]),
                 activation='relu')(decoder_input)

x = layers.Reshape(shape_before_flattening[1:])(x)
x = layers.Conv2DTranspose(32, 3,
                           padding='same',
                           activation='relu',
                           strides=(2, 2))(x)
x = layers.Conv2D(1, 3,
                  padding='same',
                  activation='sigmoid')(x)

decoder = Model(decoder_input, x)

z_decoded = decoder(z)
class CustomVariationalLayer(keras.layers.Layer):

    def vae_loss(self, x, z_decoded):
        x = K.flatten(x)
        z_decoded = K.flatten(z_decoded)
        xent_loss = keras.metrics.binary_crossentropy(x, z_decoded)
        kl_loss = -5e-4 * K.mean(
            1 + z_log_var - K.square(z_mean) - K.exp(z_log_var), axis=-1)
        return K.mean(xent_loss + kl_loss)

    def call(self, inputs):
        x = inputs[0]
        z_decoded = inputs[1]
        loss = self.vae_loss(x, z_decoded)
        self.add_loss(loss, inputs=inputs)
        return x

y = CustomVariationalLayer()([input_img, z_decoded])

vae = Model(input_img, y)
vae.compile(optimizer='rmsprop', loss=None)
vae.summary()

(x_train, _), (x_test, y_test) = mnist.load_data()

x_train = x_train.astype('float32') / 255.
x_train = x_train.reshape(x_train.shape + (1,))
x_test = x_test.astype('float32') / 255.
x_test = x_test.reshape(x_test.shape + (1,))

vae.fit(x=x_train, y=None,
        shuffle=True,
        epochs=1,
        batch_size=batch_size,
        validation_data=(x_test, None))

import matplotlib.pyplot as plt
from scipy.stats import norm

n = 15
digit_size = 28
figure = np.zeros((digit_size * n, digit_size * n))
grid_x = norm.ppf(np.linspace(0.05, 0.95, n))
grid_y = norm.ppf(np.linspace(0.05, 0.95, n))

for i, yi in enumerate(grid_x):
    for j, xi in enumerate(grid_y):
        z_sample = np.array([[xi, yi]])
        z_sample = np.tile(z_sample, batch_size).reshape(batch_size, 2)
        x_decoded = decoder.predict(z_sample, batch_size=batch_size)
        digit = x_decoded[0].reshape(digit_size, digit_size)
        figure[i * digit_size: (i + 1) * digit_size,
               j * digit_size: (j + 1) * digit_size] = digit

plt.figure(figsize=(15, 15))
plt.imshow(figure, cmap='Greys_r')
plt.show()
```

```
WARNING:tensorflow:Output custom_variational_layer_3 missing from loss
dictionary. We assume this was done on purpose. The fit and evaluate APIs will
not be expecting any data to be passed to custom_variational_layer_3.
Model: "model_7"
________________________________________________________________________________
__________________
Layer (type)                    Output Shape         Param #     Connected to
================================================================================
==================
input_5 (InputLayer)            [(None, 28, 28, 1)]  0

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__________________
conv2d_15 (Conv2D)              (None, 28, 28, 32)   320         input_5[0][0]

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conv2d_16 (Conv2D)              (None, 14, 14, 64)   18496       conv2d_15[0][0]
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conv2d_17 (Conv2D)              (None, 14, 14, 64)   36928       conv2d_16[0][0]
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__________________
conv2d_18 (Conv2D)              (None, 14, 14, 64)   36928       conv2d_17[0][0]
________________________________________________________________________________
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flatten_3 (Flatten)             (None, 12544)        0           conv2d_18[0][0]
________________________________________________________________________________
__________________
dense_12 (Dense)                (None, 32)           401440      flatten_3[0][0]
________________________________________________________________________________
__________________
dense_13 (Dense)                (None, 2)            66          dense_12[0][0]
________________________________________________________________________________
__________________
dense_14 (Dense)                (None, 2)            66          dense_12[0][0]
________________________________________________________________________________
__________________
lambda_3 (Lambda)               (None, 2)            0           dense_13[0][0]
                                                                 dense_14[0][0]
________________________________________________________________________________
__________________
model_6 (Functional)            (None, 28, 28, 1)    56385       lambda_3[0][0]
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custom_variational_layer_3 (Cus (None, 28, 28, 1)    0           input_5[0][0]
                                                                 model_6[0][0]
================================================================================
==================
Total params: 550,629
Trainable params: 550,629
Non-trainable params: 0
________________________________________________________________________________
__________________
Train on 60000 samples, validate on 10000 samples
59968/60000 [============================>.] - ETA: 0s - loss: 0.2178

/opt/conda/lib/python3.8/site-
packages/tensorflow/python/keras/engine/training.py:2325: UserWarning:
`Model.state_updates` will be removed in a future version. This property should
not be used in TensorFlow 2.0, as `updates` are applied automatically.
  warnings.warn('`Model.state_updates` will be removed in a future version. '

60000/60000 [==============================] - 84s 1ms/sample - loss: 0.2178 -
val_loss: 0.2020
```

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/opt/conda/lib/python3.8/site-
packages/tensorflow/python/keras/engine/training.py:2325: UserWarning:
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```

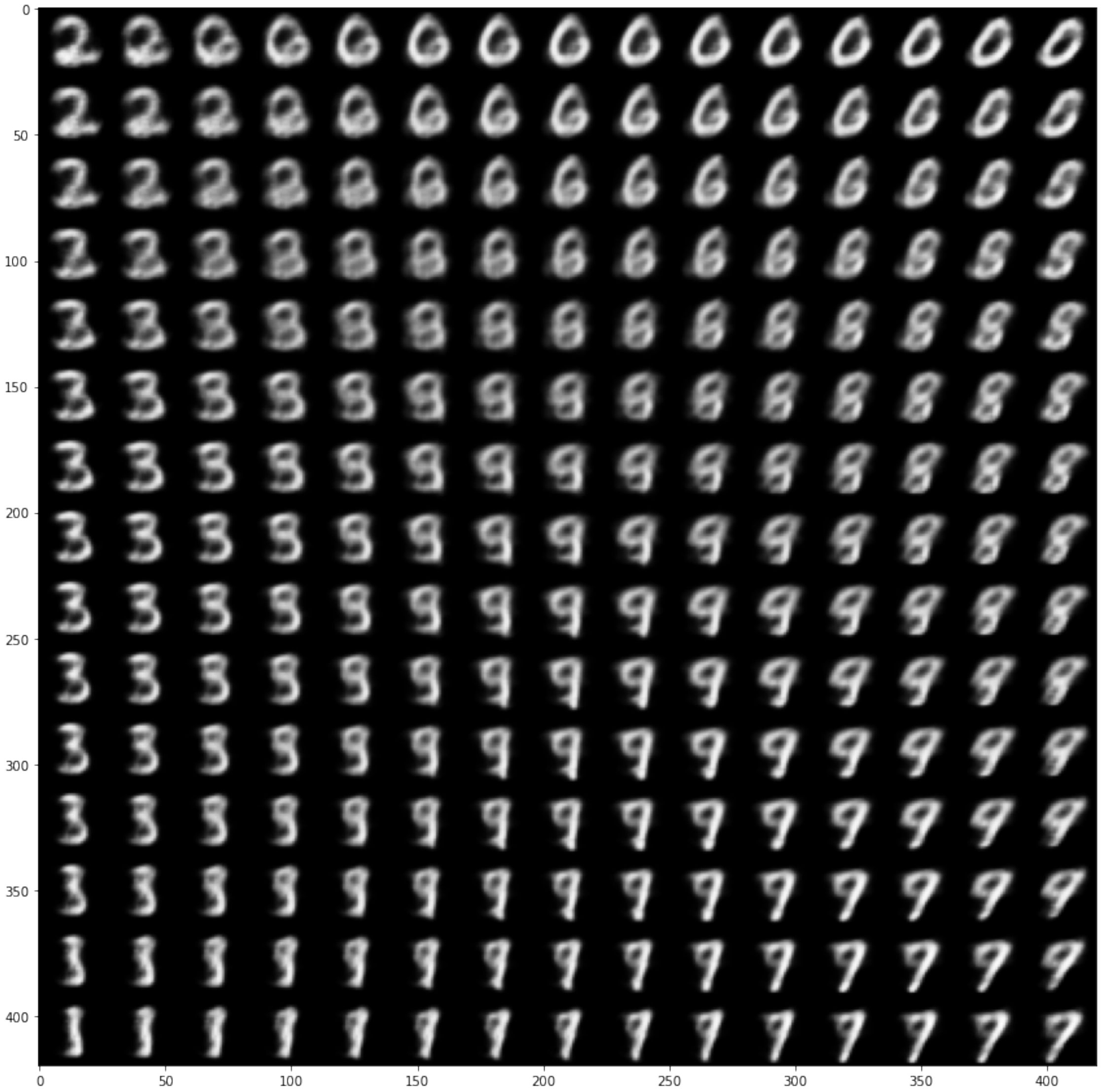

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