Реализовать синтезирование лиц из LFW с помощью DCGAN

Библиотеки: [Python, Tensorflow]

```
import numpy as np
import tensorflow_datasets as tfds
import tensorflow as tf

%matplotlib inline
import matplotlib.pyplot as plt
import time

import warnings
warnings.filterwarnings('ignore')
```

```
tf.__version__
```

```
'2.9.2'
```

```
(train_ds, test_ds), ds_info = tfds.load(
    'lfw',
    as_supervised=True,
    with_info=True,
    split=['train[:90%]', 'train[90%:]'],
)
```

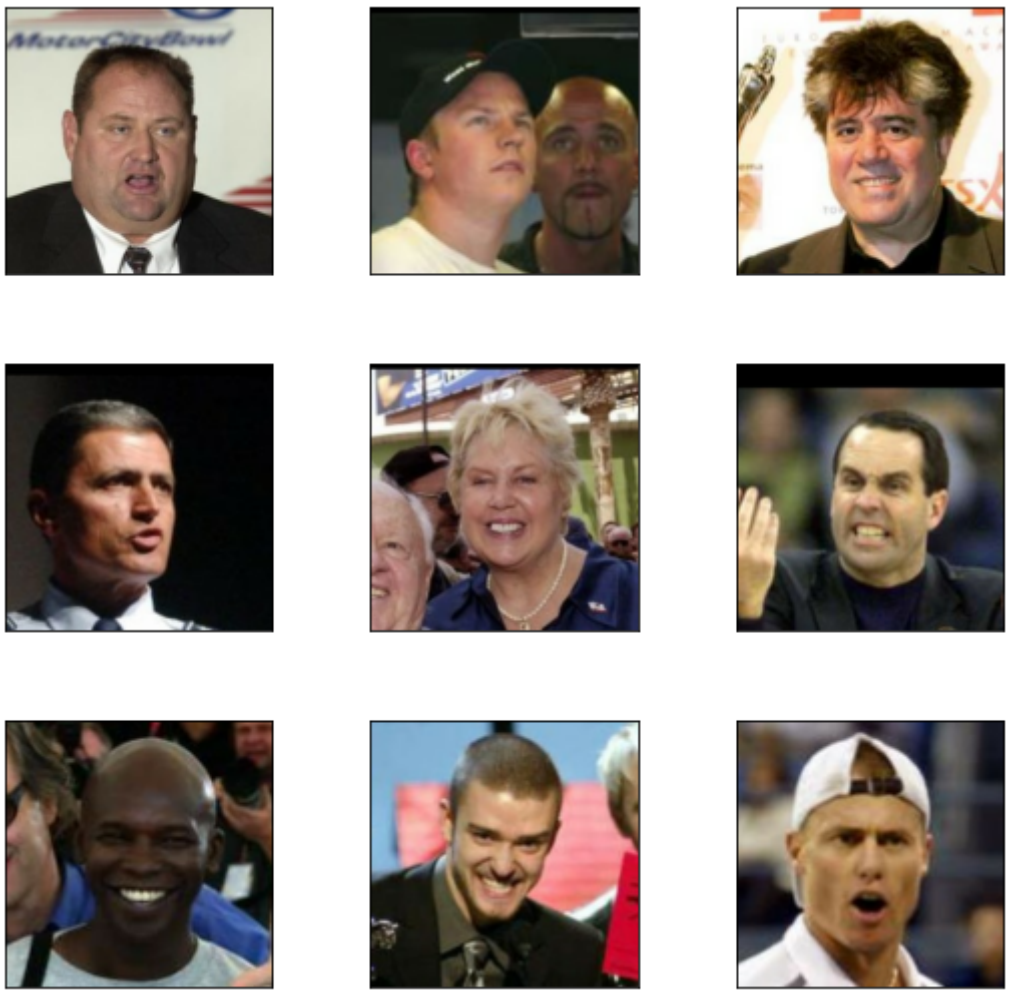
```
ds_info
```

```
tfds.core.DatasetInfo(
    name='lfw',
    full_name='lfw/0.1.0',
    description="""
    Labeled Faces in the Wild:
            A Database for Studying Face Recognition in
            Unconstrained Environments
    """,
    homepage='http://vis-www.cs.umass.edu/lfw',
    data_path='~/tensorflow_datasets/lfw/0.1.0',
    file_format=tfrecord,
    download_size=172.20 MiB,
    dataset_size=180.28 MiB,
    features=FeaturesDict({
        'image': Image(shape=(250, 250, 3), dtype=tf.uint8),
        'label': Text(shape=(), dtype=tf.string),
    }),
    supervised_keys=('label', 'image'),
    disable_shuffling=False,
    splits={
        'train': <SplitInfo num_examples=13233, num_shards=2>,
    },
    citation="""@TechReport{LFWTech,
        author = {Gary B. Huang and Manu Ramesh and Tamara Berg and Erik Learned-
Miller},
```

```
            title = {Labeled Faces in the Wild: A Database for Studying Face Recognition
    in Unconstrained Environments},
            institution = {University of Massachusetts, Amherst},
            year = 2007,
            number = {07-49},
            month = {October}
        }""",
    )
```

Визуализация

```
fig = tfds.show_examples(train_ds, ds_info=ds_info)
```



```
INPUT_DIM = 128
IMG_SIZE = 128
NUM_EPOCHS = 20
BATCH_SIZE = 20
HALF_BATCH_SIZE = 10

LEARNING_RATE = 0.0001


def prepare(label, img):
    img = tf.cast(img, tf.float32) / 255.
    return tf.image.resize(img, (IMG_SIZE, IMG_SIZE))
```

```
train_ds = train_ds.shuffle(buffer_size=len(train_ds))
train_ds = train_ds.map(prepare)
train_ds = train_ds.repeat(NUM_EPOCHS)
train_ds = train_ds.batch(HALF_BATCH_SIZE, drop_remainder=True)
```

```
num_steps = len(train_ds) - 1
num_steps
```

```
23819
```

Deep Convolutional GAN (DCGAN)

```
generator = tf.keras.Sequential([
    tf.keras.layers.Dense(256*32*32),
    tf.keras.layers.Dropout(0.1),
    tf.keras.layers.LeakyReLU(alpha=0.2),
    tf.keras.layers.Reshape((32, 32, 256)),
    tf.keras.layers.Conv2DTranspose(256, (2, 2), strides=(2, 2), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.Conv2D(256, (3, 3), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.LeakyReLU(alpha=0.2),
    tf.keras.layers.Conv2DTranspose(128, (3, 3), strides=(2, 2), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.Conv2D(128, (3, 3), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.LeakyReLU(alpha=0.2),
    tf.keras.layers.Conv2D(3, (3, 3), padding='same', activation='sigmoid'),
])
```

```
discriminator = tf.keras.Sequential([
    tf.keras.layers.Conv2D(32, (5, 5), strides=(2, 2), padding='same'),
    tf.keras.layers.LeakyReLU(0.2),
    tf.keras.layers.Conv2D(64, kernel_size=3, strides=(2, 2), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.LeakyReLU(alpha=0.2),
    tf.keras.layers.Conv2D(128, kernel_size=3, strides=(2, 2), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.LeakyReLU(alpha=0.2),
    tf.keras.layers.Conv2D(256, kernel_size=2, strides=(1, 1), padding='same'),
    tf.keras.layers.BatchNormalization(momentum=0.8),
    tf.keras.layers.LeakyReLU(alpha=0.2),
    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(128),
    tf.keras.layers.Dropout(0.25),
    tf.keras.layers.Dense(1),
])
```

Обучение

```
optimizer = tf.keras.optimizers.Adam(LEARNING_RATE)
sigmoid_cross_entropy = tf.keras.losses.BinaryCrossentropy(from_logits=True)


def plot_results(samples):
    fig = plt.figure(figsize=(16, 10))
    num = samples.shape[0]
    for j in range(num):
        ax = fig.add_subplot(8, 8, j+1)
        ax.imshow((samples[j, ...].reshape(IMG_SIZE, IMG_SIZE, 3)))
        plt.xticks([]),
        plt.yticks([])
    plt.show()


%%time

start = time.time()
for step, true_images in enumerate(train_ds):

    # Train Discriminator

    noise = np.random.normal(0, 1, (HALF_BATCH_SIZE, INPUT_DIM)).astype(np.float32)
    syntetic_images = generator.predict(noise)
    x_combined = np.concatenate((
        true_images,
        syntetic_images))
    y_combined = np.concatenate((
        np.ones((HALF_BATCH_SIZE, 1), np.float32),
        np.zeros((HALF_BATCH_SIZE, 1), np.float32)))

    with tf.GradientTape() as tape:
        logits = discriminator(x_combined, training=True)
        d_loss_value = sigmoid_cross_entropy(y_combined, logits)
    grads = tape.gradient(d_loss_value, discriminator.trainable_variables)
    optimizer.apply_gradients(zip(grads, discriminator.trainable_variables))

    # Train Generator

    noise = np.random.normal(0, 1, (BATCH_SIZE, INPUT_DIM)).astype(np.float32)
    y_mislabled = np.ones((BATCH_SIZE, 1), np.float32)

    with tf.GradientTape() as tape:
        syntetic = generator(noise, training=True)
        logits = discriminator(syntetic, training=False)
        g_loss_value = sigmoid_cross_entropy(y_mislabled, logits)
    grads = tape.gradient(g_loss_value, generator.trainable_variables)
    optimizer.apply_gradients(zip(grads, generator.trainable_variables))


    if (step % 2000 == 0) or (step == num_steps):
        print('[Step %2d] D Loss: %.4f; G Loss: %.4f;' % (
            step, d_loss_value.numpy(), g_loss_value.numpy()), f'time taken ----> {round((
        noise = np.random.normal(0, 1, (8, INPUT_DIM)).astype(np.float32)
```

```
            syntetic_images = generator.predict(noise)
            plot_results(syntetic_images)
            start = time.time()
```

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