Devanagari GAN

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1 General Imports

[1]:
```
from os import getcwd, listdir, mkdir
from tqdm import tqdm
import cv2
from random import shuffle
import matplotlib.pyplot as plt
import sys
import numpy as np
```

[2]:
```
DATA_DIR = "/characters/"
DATA_LOCATION = getcwd() + DATA_DIR
character_names = listdir(DATA_LOCATION)
```

[3]:
```
def create_data(images_list):
    data = []
    for image_location in tqdm(images_list):
        character_name = image_location.split('/')[-2]
        resized_image = cv2.resize(cv2.imread(
            image_location, flags=cv2.IMREAD_GRAYSCALE), (32, 32),␣
 ↪interpolation=cv2.INTER_AREA)
        data.append([np.array(resized_image), character_name])
    shuffle(data)
    return data
```

2 Tensorflow Imports

[4]:
```
from tensorflow.keras.datasets import mnist
from tensorflow.keras.layers import Input, Dense, Reshape, Flatten, Dropout
from tensorflow.keras.layers import BatchNormalization, Activation,␣
 ↪ZeroPadding2D
from tensorflow.keras.layers import LeakyReLU
from tensorflow.keras.layers import UpSampling2D, Conv2D
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.optimizers import Adam
```

3 GAN

Implementation of Generative Adversarial Network with a MLP generator and discriminator.

Code: https://github.com/eriklindernoren/Keras-GAN/blob/master/gan/gan.py

Paper: https://arxiv.org/abs/1406.2661

[5]:
```
img_rows = 32
img_cols = 32
channels = 1
img_shape = (img_rows, img_cols, channels)
latent_dim = 100
epochs = 10001
batch_size = 64
sample_interval = 500
optimizer = Adam(0.0002, 0.5)

try:
    mkdir("./gan_output")
except:
    pass
```

[6]:
```
def build_generator():
    model = Sequential()

    model.add(Dense(256, input_dim=latent_dim))
    model.add(LeakyReLU(alpha=0.2))
    model.add(BatchNormalization(momentum=0.8))
    model.add(Dense(512))
    model.add(LeakyReLU(alpha=0.2))
    model.add(BatchNormalization(momentum=0.8))
    model.add(Dense(1024))
    model.add(LeakyReLU(alpha=0.2))
    model.add(BatchNormalization(momentum=0.8))
    model.add(Dense(np.prod(img_shape), activation='tanh'))
    model.add(Reshape(img_shape))

    # model.summary()

    noise = Input(shape=(latent_dim,))
    img = model(noise)

    return Model(noise, img)
```

[7]:
```
def build_discriminator():
    model = Sequential()

    model.add(Flatten(input_shape=img_shape))
```

```
    model.add(Dense(512))
    model.add(LeakyReLU(alpha=0.2))
    model.add(Dense(256))
    model.add(LeakyReLU(alpha=0.2))
    model.add(Dense(1, activation='sigmoid'))

    # model.summary()

    img = Input(shape=img_shape)
    validity = model(img)

    return Model(img, validity)
```

[8]:
```
def train(training_data, character_name, epochs, batch_size=128,␣
↪sample_interval=50, save_location=None, verbose=False):
    # Load the dataset
    X_train = training_data

    # Rescale -1 to 1
    # X_train = X_train / 127.5 - 1.
    # X_train = np.expand_dims(X_train, axis=3)

    # Adversarial ground truths
    valid = np.ones((batch_size, 1))
    fake = np.zeros((batch_size, 1))

    for epoch in tqdm(range(epochs)):

        # ---------------------
        #  Train Discriminator
        # ---------------------

        # Select a random batch of images
        idx = np.random.randint(0, X_train.shape[0], batch_size)
        imgs = X_train[idx]

        noise = np.random.normal(0, 1, (batch_size, latent_dim))

        # Generate a batch of new images
        gen_imgs = generator.predict(noise)

        # Train the discriminator
        d_loss_real = discriminator.train_on_batch(imgs, valid)
        d_loss_fake = discriminator.train_on_batch(gen_imgs, fake)
        d_loss = 0.5 * np.add(d_loss_real, d_loss_fake)

        # ---------------------
```

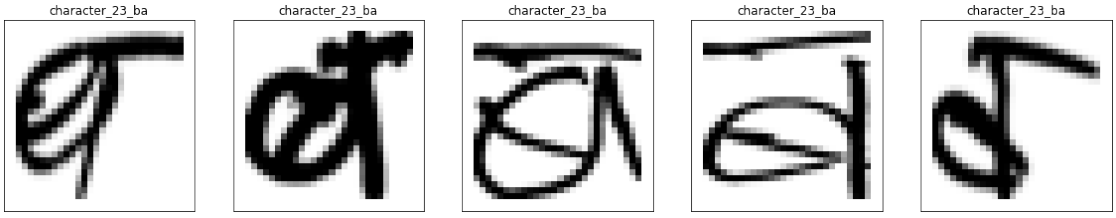
```
        #  Train Generator
        # ---------------------

        noise = np.random.normal(0, 1, (batch_size, latent_dim))

        # Train the generator (to have the discriminator label samples as valid)
        g_loss = combined.train_on_batch(noise, valid)

        # Plot the progress
        if verbose:
            print("%d [D loss: %f, acc.: %.2f%%] [G loss: %f]" %
                  (epoch, d_loss[0], 100*d_loss[1], g_loss))

        # If at save interval => save generated image samples
        if epoch % sample_interval == 0:
            sample_images(epoch, character_name=character_name,
                          location=save_location)
```

[9]:
```
def sample_images(epoch, character_name, location='/undefined'):
    r, c = 10, 10
    noise = np.random.normal(0, 1, (r * c, latent_dim))
    gen_imgs = generator.predict(noise)

    # Rescale images 0 - 1
    gen_imgs = 0.5 * gen_imgs + 0.5

    fig, axs = plt.subplots(r, c)
    # fig = plt.figure(figsize=(20, 15))
    cnt = 0

    try:
        mkdir('%s/individual' % location)
    except:
        pass

    for i in range(r):
        for j in range(c):

            plt.imsave('%s/individual/%d.png' %
                       (location, cnt), gen_imgs[cnt, :, :, 0], cmap='gray_r')
            axs[i, j].imshow(gen_imgs[cnt, :, :, 0], cmap='gray_r')
            axs[i, j].axis('off')
            cnt += 1
    fig.savefig("%s/%d.png" % (location, epoch))
    plt.close()
```

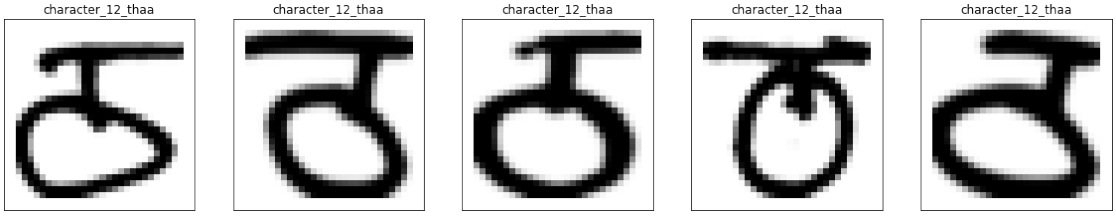
[10]:
```
for character_name in character_names:
    print("For %s" % character_name)
    character_location = DATA_LOCATION + character_name
    character_location_combined = []

    for image_file in listdir(character_location):
        character_location_combined.append(
            character_location + '/' + image_file)

    character_image_data = create_data(character_location_combined)

    print("Reshaping Data...")
    x_train = np.expand_dims(
        np.array([i[0] for i in character_image_data]), axis=-1)
    x_train = x_train.astype('float32')
    x_train = x_train / 255.0
    y_train = np.array([i[1] for i in character_image_data]).reshape(-1, 1)

    print("Shapes: x_train = %s, y_train = %s" %
          (x_train.shape, y_train.shape))

    fig = plt.figure(figsize=(20, 15))
    for i in range(5):
        ax = fig.add_subplot(1, 5, 1 + i, xticks=[], yticks=[])
        plt.imshow(character_image_data[i][0], cmap='gray_r')
        plt.title(character_image_data[i][1])
    plt.show()

    # Build and compile the discriminator
    discriminator = build_discriminator()
    discriminator.compile(loss='binary_crossentropy',
                                optimizer=optimizer,
                                metrics=['accuracy'])

    # Build the generator
    generator = build_generator()

    # The generator takes noise as input and generates imgs
    z = Input(shape=(latent_dim,))
    img = generator(z)

    # For the combined model we will only train the generator
    discriminator.trainable = False

    # The discriminator takes generated images as input and determines validity
    validity = discriminator(img)
```

```
    # The combined model  (stacked generator and discriminator)
    # Trains the generator to fool the discriminator
    combined = Model(z, validity)
    combined.compile(loss='binary_crossentropy', optimizer=optimizer)

    # Train the model
    try:
        mkdir("gan_output/%s" % character_name)
    except:
        pass
    train(training_data=x_train, character_name=character_name, epochs=epochs,
          batch_size=batch_size, sample_interval=sample_interval,␣
↪save_location="gan_output/%s" % character_name)
```

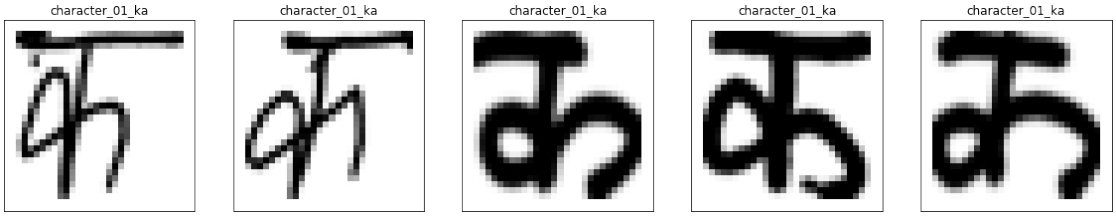
```
100%|      | 2000/2000 [00:00<00:00, 23417.93it/s]

For character_23_ba
Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```



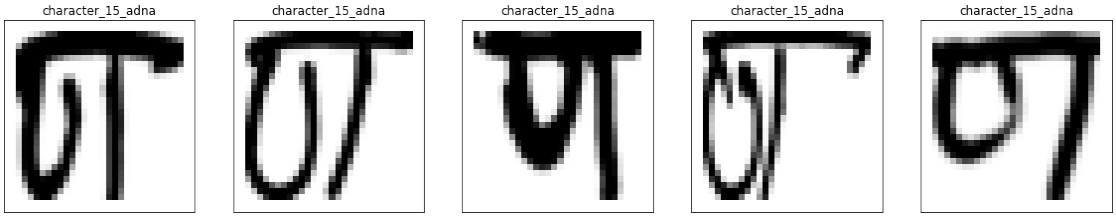

```
100%|      | 10001/10001 [11:17<00:00, 14.77it/s]
 34%|        | 690/2000 [00:00<00:00, 6895.30it/s]

For character_12_thaa

100%|      | 2000/2000 [00:00<00:00, 6813.48it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```



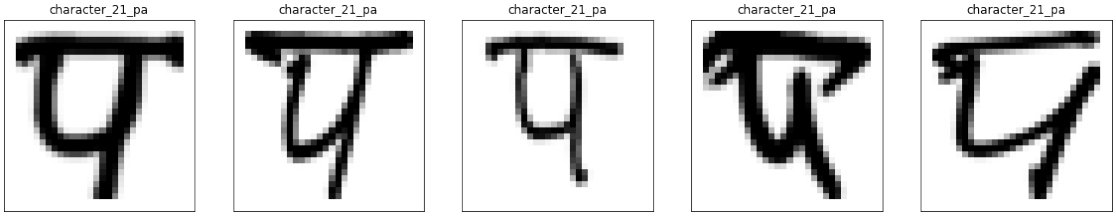
```
100%|      | 10001/10001 [11:16<00:00, 14.78it/s]
 33%|        | 662/2000 [00:00<00:00, 6613.92it/s]

For character_01_ka

100%|      | 2000/2000 [00:00<00:00, 6469.34it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```




```
100%|      | 10001/10001 [11:17<00:00, 14.76it/s]
 33%|        | 656/2000 [00:00<00:00, 6553.69it/s]

For character_15_adna

100%|      | 2000/2000 [00:00<00:00, 6709.77it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```




```
100%|      | 10001/10001 [11:16<00:00, 14.79it/s]
 34%|        | 685/2000 [00:00<00:00, 6843.79it/s]

For character_21_pa

100%|      | 2000/2000 [00:00<00:00, 6702.24it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```




```
100%|      | 10001/10001 [11:19<00:00, 14.73it/s]
 34%|        | 673/2000 [00:00<00:00, 6723.90it/s]
```

For character_13_daa

```
100%|      | 2000/2000 [00:00<00:00, 6870.02it/s]
```

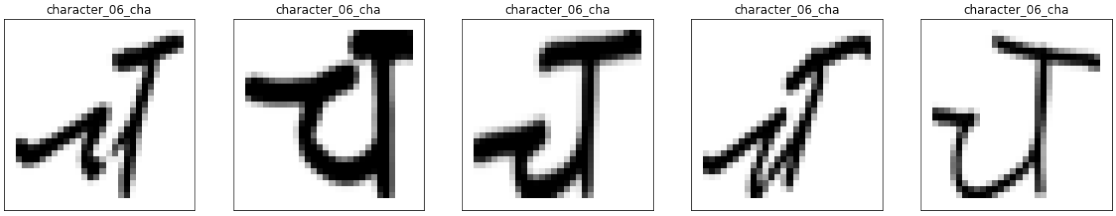
Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)


```
100%|      | 10001/10001 [11:18<00:00, 14.75it/s]
 34%|        | 690/2000 [00:00<00:00, 6894.81it/s]
```

For character_06_cha

```
100%|      | 2000/2000 [00:00<00:00, 6585.67it/s]
```

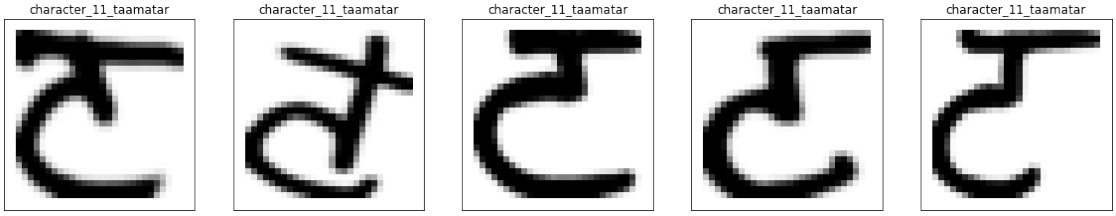
Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)



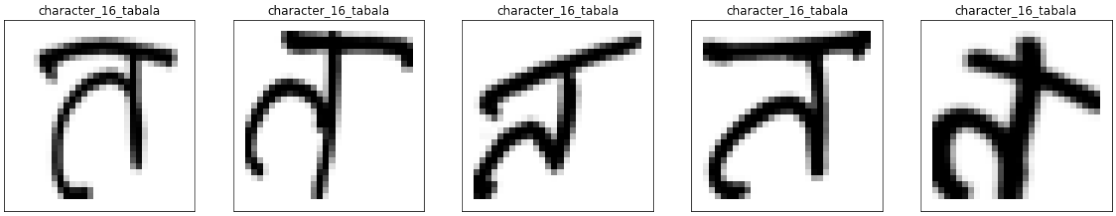

```
100%|      | 10001/10001 [11:21<00:00, 14.68it/s]
 34%|        | 684/2000 [00:00<00:00, 6834.34it/s]
```

For character_11_taamatar

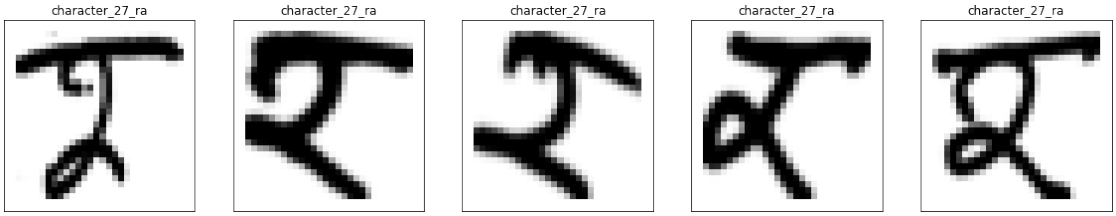
```
100%|      | 2000/2000 [00:00<00:00, 6845.57it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```




```
100%|      | 10001/10001 [11:14<00:00, 14.82it/s]
 35%|        | 707/2000 [00:00<00:00, 7064.48it/s]

For character_16_tabala

100%|      | 2000/2000 [00:00<00:00, 6900.19it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```




```
100%|      | 10001/10001 [11:15<00:00, 14.81it/s]
 35%|        | 694/2000 [00:00<00:00, 6939.46it/s]

For character_27_ra

100%|      | 2000/2000 [00:00<00:00, 6704.76it/s]

Reshaping Data…
Shapes: x_train = (2000, 32, 32, 1), y_train = (2000, 1)
```



```
100%|      | 10001/10001 [11:18<00:00, 14.74it/s]
```