

```

import tensorflow as tf
import os
import pathlib
import glob
from matplotlib import pyplot as plt

dataset_name = "facades"
_URL = f'http://efrosgans.eecs.berkeley.edu/pix2pix/datasets/{dataset_name}.tar.gz'

path_to_zip = pathlib.Path(tf.keras.utils.get_file(
    f'{dataset_name}.tar.gz', origin=_URL, extract=True))

root_path = path_to_zip.parent
search_pattern = str(root_path / "*" / "train")
found_dirs = glob.glob(search_pattern, recursive=True)

if not found_dirs:
    raise FileNotFoundError(f"Could not find 'train' folder in {root_path}")

PATH = pathlib.Path(found_dirs[0]).parent
print(f"Verified Dataset Path: {PATH}")

BUFFER_SIZE = 400
BATCH_SIZE = 1
IMG_WIDTH = 256
IMG_HEIGHT = 256

def load(image_file):
    image = tf.io.read_file(image_file)
    image = tf.io.decode_jpeg(image)
    w = tf.shape(image)[1]
    w = w // 2
    real_image = image[:, :w, :]
    input_image = image[:, w:, :]
    input_image = tf.cast(input_image, tf.float32)
    real_image = tf.cast(real_image, tf.float32)
    return input_image, real_image

def normalize(input_image, real_image):
    input_image = (input_image / 127.5) - 1
    real_image = (real_image / 127.5) - 1
    return input_image, real_image

@tf.function
def load_image_train(image_file):
    input_image, real_image = load(image_file)
    input_image = tf.image.resize(input_image, [IMG_HEIGHT, IMG_WIDTH])
    real_image = tf.image.resize(real_image, [IMG_HEIGHT, IMG_WIDTH])
    input_image, real_image = normalize(input_image, real_image)
    return input_image, real_image

train_dataset = tf.data.Dataset.list_files(str(PATH / 'train/*.jpg'))
train_dataset = train_dataset.map(load_image_train, num_parallel_calls=tf.data.AUTOTUNE)
train_dataset = train_dataset.shuffle(BUFFER_SIZE).batch(BATCH_SIZE)

try:
    test_dataset = tf.data.Dataset.list_files(str(PATH / 'test/*.jpg'))
except tf.errors.InvalidArgumentError:
    test_dataset = tf.data.Dataset.list_files(str(PATH / 'val/*.jpg'))

test_dataset = test_dataset.map(load_image_train).batch(BATCH_SIZE)

print("Datasets loaded successfully!")

```

Downloading data from <http://efrosgans.eecs.berkeley.edu/pix2pix/datasets/facades.tar.gz>  
 30168306/30168306 ————— 5s 0us/step  
 Verified Dataset Path: /root/.keras/datasets/facades\_extracted/facades  
 Datasets loaded successfully!

OUTPUT\_CHANNELS = 3

```

def downsample(filters, size, apply_batchnorm=True):
    initializer = tf.random_normal_initializer(0., 0.02)
    result = tf.keras.Sequential()
    result.add(tf.keras.layers.Conv2D(filters, size, strides=2, padding='same',
                                       kernel_initializer=initializer, use_bias=False))
    if apply_batchnorm:
        result.add(tf.keras.layers.BatchNormalization())
    result.add(tf.keras.layers.LeakyReLU())
    return result

```

```

def upsample(filters, size, apply_dropout=False):
    initializer = tf.random_normal_initializer(0., 0.02)
    result = tf.keras.Sequential()
    result.add(tf.keras.layers.Conv2DTranspose(filters, size, strides=2, padding='same',
                                                kernel_initializer=initializer, use_bias=False))
    result.add(tf.keras.layers.BatchNormalization())
    if apply_dropout:
        result.add(tf.keras.layers.Dropout(0.5))
    result.add(tf.keras.layers.ReLU())
    return result

def Generator():
    inputs = tf.keras.layers.Input(shape=[256, 256, 3])

    down_stack = [
        downsample(64, 4, apply_batchnorm=False),
        downsample(128, 4),
        downsample(256, 4),
        downsample(512, 4),
        downsample(512, 4),
        downsample(512, 4),
        downsample(512, 4),
        downsample(512, 4),
    ]

    up_stack = [
        upsample(512, 4, apply_dropout=True),
        upsample(512, 4, apply_dropout=True),
        upsample(512, 4, apply_dropout=True),
        upsample(512, 4),
        upsample(256, 4),
        upsample(128, 4),
        upsample(64, 4),
    ]

    initializer = tf.random_normal_initializer(0., 0.02)
    last = tf.keras.layers.Conv2DTranspose(OUTPUT_CHANNELS, 4, strides=2,
                                            padding='same', kernel_initializer=initializer,
                                            activation='tanh')

    x = inputs
    skips = []
    for down in down_stack:
        x = down(x)
        skips.append(x)

    skips = reversed(skips[:-1])

    for up, skip in zip(up_stack, skips):
        x = up(x)
        x = tf.keras.layers.Concatenate()([x, skip])

    x = last(x)
    return tf.keras.Model(inputs=inputs, outputs=x)

generator = Generator()

```

```
def Discriminator():
    initializer = tf.random_normal_initializer(0., 0.02)

    inp = tf.keras.layers.Input(shape=[256, 256, 3], name='input_image')
    tar = tf.keras.layers.Input(shape=[256, 256, 3], name='target_image')

    x = tf.keras.layers.concatenate([inp, tar])

    down1 = downsample(64, 4, False)(x)
    down2 = downsample(128, 4)(down1)
    down3 = downsample(256, 4)(down2)

    zero_pad1 = tf.keras.layers.ZeroPadding2D()(down3)
    conv = tf.keras.layers.Conv2D(512, 4, strides=1, kernel_initializer=initializer,
                                   use_bias=False)(zero_pad1)
    batchnorm1 = tf.keras.layers.BatchNormalization()(conv)
    leaky_relu = tf.keras.layers.LeakyReLU()(batchnorm1)

    zero_pad2 = tf.keras.layers.ZeroPadding2D()(leaky_relu)
    last = tf.keras.layers.Conv2D(1, 4, strides=1, kernel_initializer=initializer)(zero_pad2)

    return tf.keras.Model(inputs=[inp, tar], outputs=last)

discriminator = Discriminator()
```

```
LAMBDA = 100
loss_object = tf.keras.losses.BinaryCrossentropy(from_logits=True)

def generator_loss(disc_generated_output, gen_output, target):
    gan_loss = loss_object(tf.ones_like(disc_generated_output), disc_generated_output)
    l1_loss = tf.reduce_mean(tf.abs(target - gen_output))
    total_gen_loss = gan_loss + (LAMBDA * l1_loss)
    return total_gen_loss, gan_loss, l1_loss

def discriminator_loss(disc_real_output, disc_generated_output):
    real_loss = loss_object(tf.ones_like(disc_real_output), disc_real_output)
    generated_loss = loss_object(tf.zeros_like(disc_generated_output), disc_generated_output)
    total_disc_loss = real_loss + generated_loss
    return total_disc_loss

generator_optimizer = tf.keras.optimizers.Adam(2e-4, beta_1=0.5)
discriminator_optimizer = tf.keras.optimizers.Adam(2e-4, beta_1=0.5)
```

```
@tf.function
def train_step(input_image, target, step):
    with tf.GradientTape() as gen_tape, tf.GradientTape() as disc_tape:
        gen_output = generator(input_image, training=True)

        disc_real_output = discriminator([input_image, target], training=True)
        disc_generated_output = discriminator([input_image, gen_output], training=True)

        gen_total_loss, gen_gan_loss, gen_l1_loss = generator_loss(disc_generated_output, gen_output, target)
        disc_loss = discriminator_loss(disc_real_output, disc_generated_output)

        generator_gradients = gen_tape.gradient(gen_total_loss, generator.trainable_variables)
        discriminator_gradients = disc_tape.gradient(disc_loss, discriminator.trainable_variables)

        generator_optimizer.apply_gradients(zip(generator_gradients, generator.trainable_variables))
        discriminator_optimizer.apply_gradients(zip(discriminator_gradients, discriminator.trainable_variables))

def fit(train_ds, steps):
    for step, (input_image, target) in train_ds.repeat().take(steps).enumerate():
        train_step(input_image, target, step)

        if step % 1000 == 0:
            print(f'Step: {step//1000}k')

fit(train_dataset, steps=40000)
```

```
Step: 0k
Step: 1k
Step: 2k
Step: 3k
Step: 4k
Step: 5k
Step: 6k
Step: 7k
Step: 8k
Step: 9k
Step: 10k
Step: 11k
Step: 12k
```

Step: 13k  
 Step: 14k  
 Step: 15k  
 Step: 16k  
 Step: 17k  
 Step: 18k  
 Step: 19k  
 Step: 20k  
 Step: 21k  
 Step: 22k  
 Step: 23k  
 Step: 24k  
 Step: 25k  
 Step: 26k  
 Step: 27k  
 Step: 28k  
 Step: 29k  
 Step: 30k  
 Step: 31k  
 Step: 32k  
 Step: 33k  
 Step: 34k  
 Step: 35k  
 Step: 36k  
 Step: 37k  
 Step: 38k  
 Step: 39k

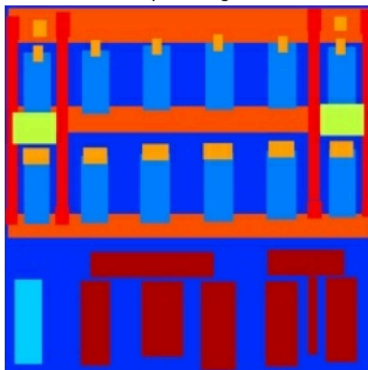
```
def generate_images(model, test_input, tar):
    prediction = model(test_input, training=True)
    plt.figure(figsize=(15, 15))

    display_list = [test_input[0], tar[0], prediction[0]]
    title = ['Input Image', 'Ground Truth', 'Predicted Image']

    for i in range(3):
        plt.subplot(1, 3, i+1)
        plt.title(title[i])
        plt.imshow(display_list[i] * 0.5 + 0.5)
        plt.axis('off')
    plt.show()

for example_input, example_target in test_dataset.take(1):
    generate_images(generator, example_input, example_target)
```

Input Image



Ground Truth



Predicted Image

