1 Fashion MNIST 練習: GAN

上一節想必大家都更了解 GAN 了，那我們來一個難一點的練習

1.1 Fashion MNIST 資料集

在 AI 的領域，MNIST 手寫數字資料集常常被視為一個表現模型好壞的量測，但大家也發現其實 MNIST 資料集的難易程度實在偏易，所以很難區分出模型到底好壞與否，於是開發出了一個稍微較難的資料集，Fashion MNIST，一樣分成十類，一樣是 60000 張訓練圖片，一樣是 28 × 28 的黑白照片，所有使用 MNIST 的練習都可以無痛轉換成為 Fashion MNIST 資料集，那我們就一起來試試看吧!

```
[程式]: # 我們會從 https 下載資料庫, MAC 電腦需要加入以下兩行, 才不會把對方的 ssl 憑證視為無效
        import ssl
        ssl._create_default_https_context = ssl._create_unverified_context
```

將 import 的對象改換成 fashion_mnist

```
[程式]: from keras.datasets import fashion_mnist
        # 回傳值: ((訓練特徵, 訓練目標), (測試特徵, 測試目標))
        (x_train, y_train),(x_test, y_test) = fashion_mnist.load_data()
```

```
Using TensorFlow backend.
```

熟悉的 shape，60000 筆 28 × 28 的資黑白照片

```
[程式]: x_train.shape
```

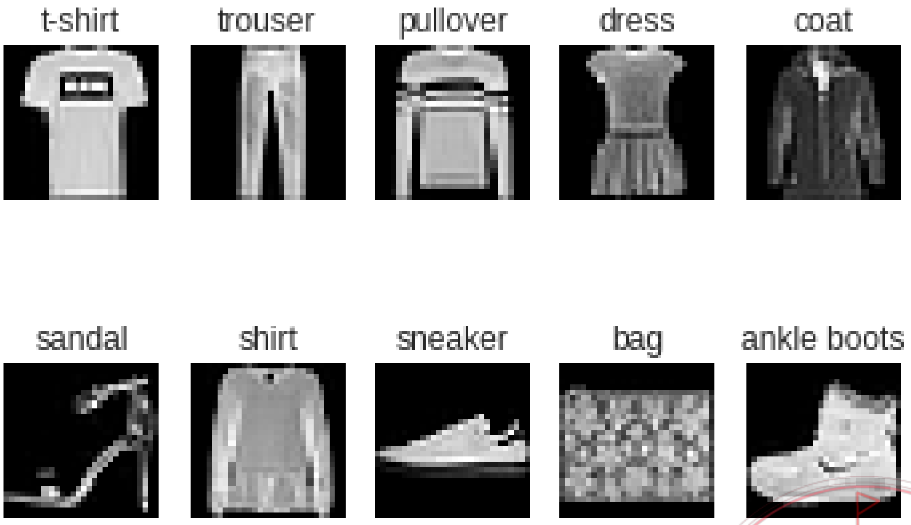
```
[輸出]: (60000, 28, 28)
```

十個分類列出如下表，分別以 0-9 表示

```
[程式]: labels = ['t-shirt', 'trouser',
                  'pullover', 'dress',
                  'coat', 'sandal',
                  'shirt', 'sneaker',
                  'bag', 'ankle boots']
```

這裡同學可以跳過，為了讓大家看看十種分類分別長什麼樣，我分別挑出一個打印出來

```
[程式]: import matplotlib.pyplot as plt
        %matplotlib inline
        import random
        # 準備在裡面塞入 {0:T-Shirt 圖片, 1: 褲子圖片...} 共十張
        samples = {}
        for (idx, label) in enumerate(y_train):
            # 取出 0-9, 如果那類圖片已經不在字典裡, 就加入進去
            if not label in samples:
                samples[label] = x_train[idx]
            # 如果已經有十個了, 代表每種都挑出一個了, 跳出
            if len(samples) == 10:
                break
        # 走過字典的時候拿出的是 key 的部分, 也就是 0-9
        # 我使用 sorted 排列為了依照順序印出
        for key in sorted(samples):
            # 把大圖切成 2 * 5 小圖, 編號為
            # 1, 2, 3, 4, 5
            # 6, 7, 8, 9, 10
            # 所以利用 key + 1 得到對應的小圖編號
            plt.subplot(2, 5, key + 1)
            # 打上對應的 title
            plt.title(labels[key])
            plt.axis('off')
            plt.imshow(samples[key], cmap='gray')
```



一樣完成標準化

```
[程式]: from keras.utils import np_utils
        # reshape 讓他從 32 * 32 變成 784 * 1 的一維陣列
        # 讓我們標準化到-1~1 區間
        x_train_shaped = (x_train.reshape(60000, 784).astype("float32") - 127.5)/127.5
        x_test_shaped = (x_test.reshape(10000, 784).astype("float32") - 127.5)/127.5
```

建立創作家，忘記概念的讀者請到 MNIST 章節參考

```
[程式]: from keras.models import Sequential
        from keras.layers import Dense, BatchNormalization

        random_dim = 100
        generator = Sequential()
        generator.add(Dense(256, input_dim=random_dim,
                            activation='relu'))
        generator.add(BatchNormalization())
        generator.add(Dense(512, activation='relu'))
        generator.add(BatchNormalization())
        generator.add(Dense(784, activation='tanh'))
        generator.compile(loss='binary_crossentropy', optimizer="adam")
        generator.summary()
```

```
Using TensorFlow backend.


_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 256)               25856
_________________________________________________________________
batch_normalization_1 (Batch (None, 256)               1024
_________________________________________________________________
dense_2 (Dense)              (None, 512)               131584
_________________________________________________________________
batch_normalization_2 (Batch (None, 512)               2048
_________________________________________________________________
dense_3 (Dense)              (None, 784)               402192
=================================================================
Total params: 562,704
Trainable params: 561,168
Non-trainable params: 1,536
_________________________________________________________________
```

建立鑑賞家

```
[程式]: from keras.layers import Dropout

        discriminator = Sequential()
        discriminator.add(Dense(1024, input_dim=784,
                                activation='relu'))
        discriminator.add(Dropout(0.25))
        discriminator.add(Dense(512, activation='relu'))
        discriminator.add(Dropout(0.25))
        discriminator.add(Dense(256, activation='relu'))
        discriminator.add(Dropout(0.25))
        discriminator.add(Dense(1, activation='sigmoid'))
        discriminator.compile(loss='binary_crossentropy', optimizer="adam")
        discriminator.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_4 (Dense)              (None, 1024)              803840
_________________________________________________________________
dropout_1 (Dropout)          (None, 1024)              0
_________________________________________________________________
dense_5 (Dense)              (None, 512)               524800
_________________________________________________________________
dropout_2 (Dropout)          (None, 512)               0
_________________________________________________________________
dense_6 (Dense)              (None, 256)               131328
_________________________________________________________________
dropout_3 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_7 (Dense)              (None, 1)                 257
=================================================================
Total params: 1,460,225
Trainable params: 1,460,225
Non-trainable params: 0
_________________________________________________________________
```

別忘記訓練的時候是需要鑑賞家幫忙鑑定的，所以把它組合起來

```
[程式]: from keras.models import Model
        from keras.layers import Input

        discriminator.trainable = False
        gan_input = Input(shape=(random_dim,))
        x = generator(gan_input)
        gan_output = discriminator(x)
```

```
gan = Model(inputs=gan_input, outputs=gan_output)
gan.compile(loss='binary_crossentropy', optimizer="adam")
gan.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         (None, 100)               0
_________________________________________________________________
sequential_1 (Sequential)    (None, 784)               562704
_________________________________________________________________
sequential_2 (Sequential)    (None, 1)                 1460225
=================================================================
Total params: 2,022,929
Trainable params: 561,168
Non-trainable params: 1,461,761
_________________________________________________________________
```

一樣創建自己的訓練流程

```
[程式]: import numpy as np

        batch_size = 200
        epoch_count = 100
        for epoch in range(0, epoch_count):
            for batch_count in range(0, 300):
                idx = np.random.randint(0, x_train.shape[0], batch_size)
                imgs = x_train_shaped[idx]

                valid = np.ones((batch_size, 1))
                fake = np.zeros((batch_size, 1))
                # 步驟 0: 讓創作家製造出 fake image
                noise = np.random.normal(0, 1, (batch_size, random_dim))
                gen_imgs = generator.predict(noise)

                # 步驟 1-1: 讓鑑賞家鑑賞對的 image
                d_loss_real = discriminator.train_on_batch(imgs, valid)
                # 步驟 1-2: 讓鑑賞家鑑賞錯的 image
                d_loss_fake = discriminator.train_on_batch(gen_imgs, fake)
                d_loss = (d_loss_real + d_loss_fake) / 2

                noise = np.random.normal(0, 1, (batch_size, random_dim))
                # 步驟 2: 訓練創作家的創作能力
                g_loss = gan.train_on_batch(noise, valid)
            if (epoch + 1) % 10 == 0:
```

```
            dash = "-" * 15
            print(dash, "epoch", epoch + 1, dash)
            print("Discriminator loss:", d_loss)
            print("Generator loss:", g_loss)
```

```
--------------- epoch 10 ---------------
Discriminator loss: 0.41798272728919983
Generator loss: 1.7886623
--------------- epoch 20 ---------------
Discriminator loss: 0.40436792373657227
Generator loss: 1.9079899
--------------- epoch 30 ---------------
Discriminator loss: 0.4095344543457031
Generator loss: 1.7306284
--------------- epoch 40 ---------------
Discriminator loss: 0.38015812635421753
Generator loss: 1.7655674
--------------- epoch 50 ---------------
Discriminator loss: 0.4015156626701355
Generator loss: 1.8157192
--------------- epoch 60 ---------------
Discriminator loss: 0.36917126178741455
Generator loss: 1.8908474
--------------- epoch 70 ---------------
Discriminator loss: 0.41656142473220825
Generator loss: 1.9993997
--------------- epoch 80 ---------------
Discriminator loss: 0.3950040638446808
Generator loss: 1.9153638
--------------- epoch 90 ---------------
Discriminator loss: 0.3120790123939514
Generator loss: 2.0849042
--------------- epoch 100 ---------------
Discriminator loss: 0.3304310441017151
Generator loss: 2.1404862
```

上面的訓練格子我大概做了 5 - 10 次。恭喜你! 你可以看到在鑑賞家的幫助下，以下的 Fashion 服飾創建的有模有樣，電腦也成為一個服裝設計師了呢!

```
[程式]: import matplotlib.pyplot as plt
        %matplotlib inline
        # 採用 100 個 samples
        examples = 100
        # 100 個 samples * 100 靈感維度
        noise = np.random.normal(0, 1, (examples, random_dim))
```

```
gen_imgs = generator.predict(noise)

# 將-1-1 轉換回 0-1
plt.figure(figsize=(10, 10))
gen_imgs = 0.5 * gen_imgs + 0.5
gen_imgs = gen_imgs.reshape(examples, 28, 28)

# 算出寬度和長度
w = 10
# 怕有餘數, 所以取整數後多 +1
h = int(examples / w) + 1
for i in range(0, examples):
    plt.subplot(h, w, i + 1)
    plt.axis('off')
    plt.imshow(gen_imgs[i], cmap='gray')
```