Assignment 4a

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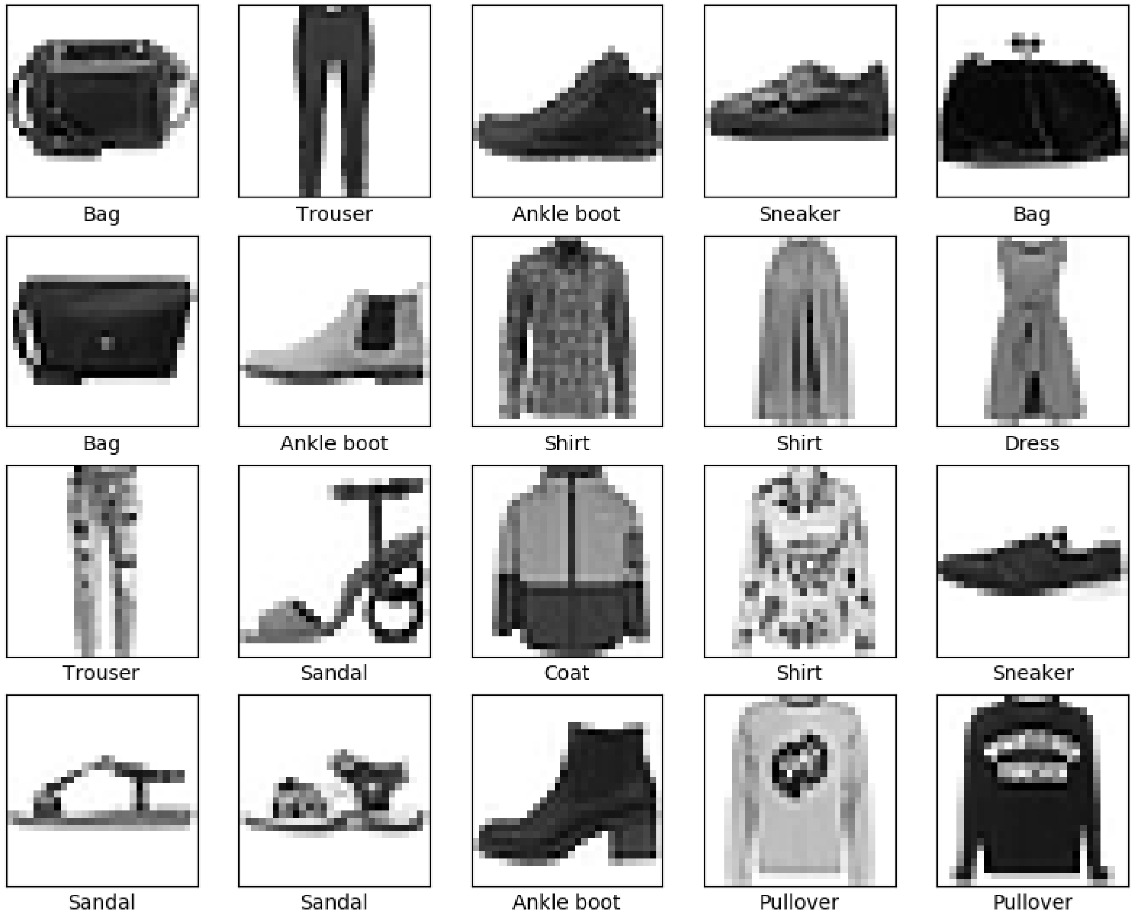
Outline

1. Fashion-MNIST with Keras
   - Model Fitting
   - Save Checkpoints

Fashion MNIST



- 70,000 images in 10 classes
- Each class has 7,000 images
- Each grayscale image is 28x28
- 60,000 images for training
- 10,000 images for testing

0	T-shirt/top
1	Trouser
2	Pullover
3	Dress
4	Coat
5	Sandal
6	Shirt
7	Sneaker
8	Bag
9	Ankle boot

Steps for Assignment 4a

1. Open assignment_4a_template.ipynb
2. Use `show_image_grids()` to see samples of Fashion-MNIST

   Understand your training data is **very important** for the success of machine learning.
3. Normalize training and test data

   ```
   train_images = train_images / 255.0
   test_images = test_images / 255.0
   ```

   After normalization, the value of each pixel is between [0,1]
4. Create a Keras Sequential Model

   ```
    model = keras.Sequential([
         keras.layers.Flatten(input_shape=input_shape),
         keras.layers.Dense(128, activation=tf.nn.relu),
         keras.layers.Dense(output_shape, activation=tf.nn.softmax)
     ])
   ```

   You need to determine input_shape and output_shape.

Steps for Assignment 4a

5. Use `model.summary()` to see the network structure of the model
6. Compile the Keras model

```
 model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
```

7. [Optional] Create TensorBoard callback

```
tb_callback = TensorBoard(log_dir='log_fashion')
```

8. Create checkpoint feedback

```
checkpoint_path = "ckpt_fashion/cp-{epoch:04d}.ckpt"
cp_callback = ModelCheckpoint(checkpoint_path, save_weights_only=True,
verbose=1, period=5)
```

Steps for Assignment 4a

9. Fit the model

```
model.fit(train_images, train_labels, epochs=20, callbacks =
[cp_callback, tb_callback])
```

10. Compute and print the test accuracy

```
test_loss, test_acc = model.evaluate(test_images, test_labels)
```

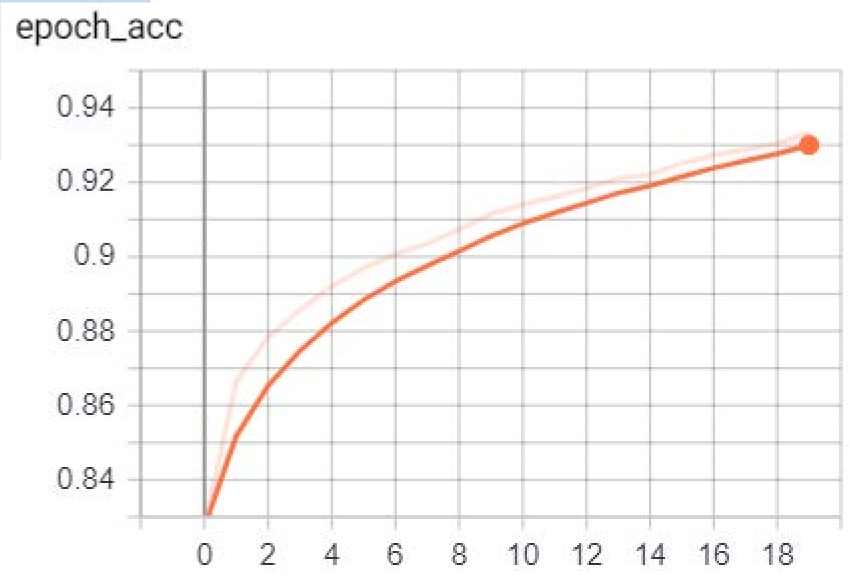
11. [Optional] Type the following command in Anaconda Prompt (make sure that log_fashion/ is in the current directory)

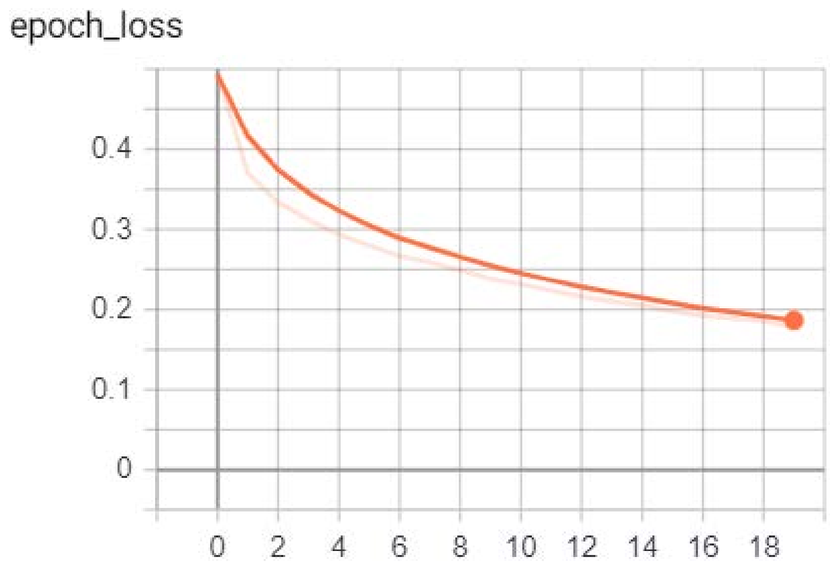
```
tensorboard.exe --logdir log_fashion
```

Navigate your web browser to `localhost:6006` to view the TensorBoard

Steps for Assignment 4a

TensorBoard will display the following two figures.





12. Compute and print the test accuracy using ckpt saved at different training epochs:

```
model.load_weights(weight_path)
loss, acc = model.evaluate(test_images, test_labels)
```

where `weight_path` is one of the following

```
ckpt_fashion/cp-0005.ckpt
ckpt_fashion/cp-0010.ckpt
ckpt_fashion/cp-0015.ckpt
ckpt_fashion/cp-0020.ckpt
```

Steps for Assignment 4a

13. Load the ckpt saved at epoch = 20.

Use `prob = model.predict(test_images)` to get the probability.

`prob.shape` is (10000,10)

`prob[i,:]` is the probability of `test_images[i,:,:]`

Compute predictions based on `prob`. For example,

if `prob[i,:]` is [0, 0.4, 0.6, 0, 0, 0, 0, 0, 0, 0],

then `predictions[i]` should be 2 (the index corresponding to the largest probability). You can use np.argmax() to compute `predictions`.

Compute and print the test accuracy by comparing `predictions` with `test_labels`. If `predictions[i]` equals `test_labels[i]`, then this means the prediction of `i`th test image is correct, otherwise the prediction is incorrect. Hint: Use the == operator.

此步驟不需要使用迴圈，如使用迴圈會被扣分。

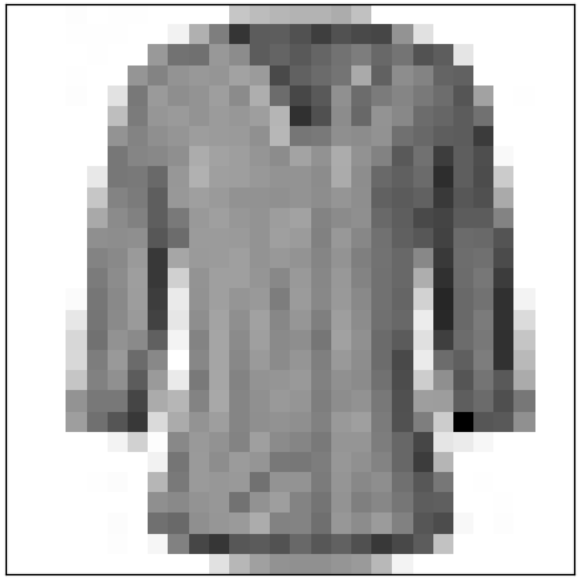
此步驟得到之 test accuracy 應該與上一頁用 `model.evaluate()`得到的 test accuracy 一致。

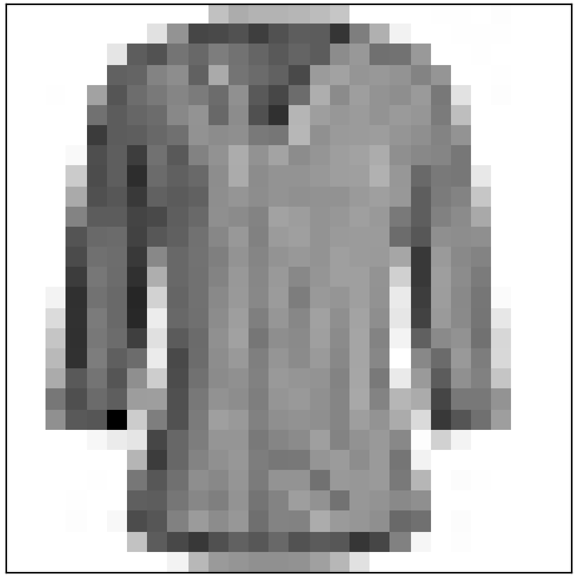
Steps for Assignment 4a

14. Display the prediction result of `test_image[4]` and `np.fliplr(test_images[4])` as in the following two figures (左圖是 `test_image[4]` 預測結果，右圖是對 `test_image[4]`左右翻轉後之預測結果).

Use `prob = model.predict(test_images[4:5])`. Note that `model.predict()`is assumed to predict multiple images at once, and

```
test_images[4:5].shape is (1,28,28)
test_images[4].shape is (28,28)
```


Shirt 55%
(Shirt is the true label)


Coat 83%
(Shirt is the true label)

```
plt.grid(False)
plt.xticks([])
plt.yticks([])
plt.imshow(img, cmap=plt.cm.binary)
plt.show()
```

- Use `plt.xlabel(description)` to display to xlabel, where `description` contains the words we wish to add to the image.
- You need to use `prob` and `class_names` to generate `description`.

Questions for Assignment 4a

1. What is the difference between the following two options in model.compile()?

    ```
    loss='categorical_crossentropy'
    loss='sparse_categorical_crossentropy'
    ```

    Use an example to illustrate the difference.