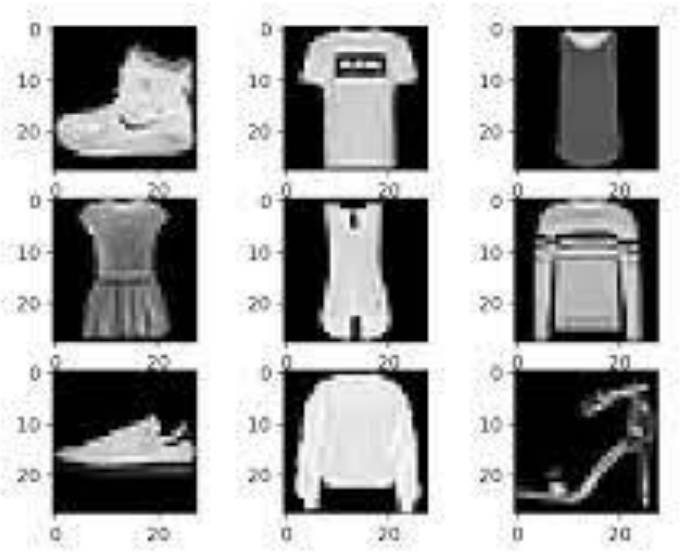
PREDICTING IMAGES OF CLOTHES USING CNN

WITH TENSORFLOW

DR. ALVIN ANG



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STEP 1: LOAD THE DATA

https://www.alvinang.sg/s/Predicting_Images_of_Clothes_using_CNN_by_Dr_Alvin_Ang.ipynb

https://keras.io/datasets/#fashion-mnist-database-of-fashion-articles

Step 1: Load the Data

Link https://keras.io/datasets/#fashion-mnist-database-of-fashion-articles

Dataset of 60,000 28x28 grayscale images of 10 fashion categories, along with a test set of 10,000 images. The class labels are:

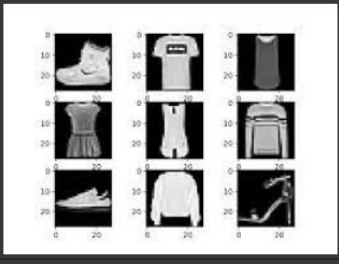
Label	Description
0	T-shirt/top
1	Trouser
2	Pullover
3	Dress
4	Coat
5	Sandal
6	Shirt
7	Sneaker
8	Bag
9	Ankle boot

Usage:

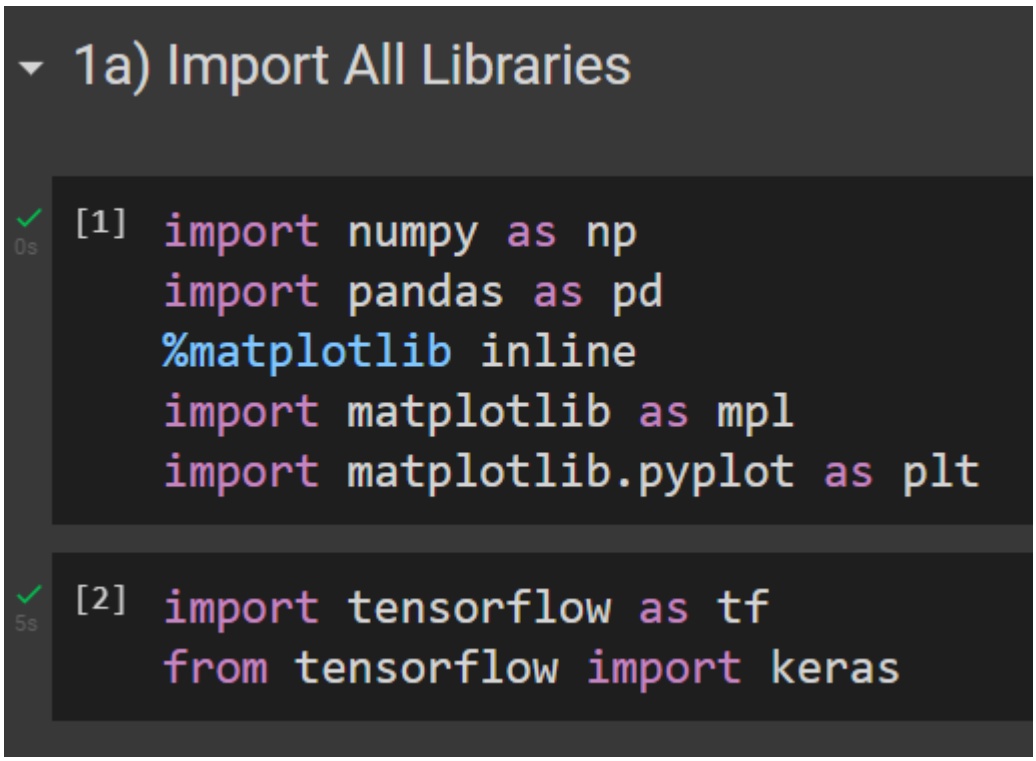
```
from keras.datasets import fashion_mnist

    (x_train, y_train), (x_test, y_test) = fashion_mnist.load_data()
```

Returns: 2 tuples:

1. x_train, x_test: uint8 array of grayscale image data with shape (num_samples, 28, 28).
2. y_train, y_test: uint8 array of labels (integers in range 0-9) with shape (num_samples,).



A. IMPORT ALL LIBRARIES



B. IMPORT THE DATA + TRAIN TEST SPLIT

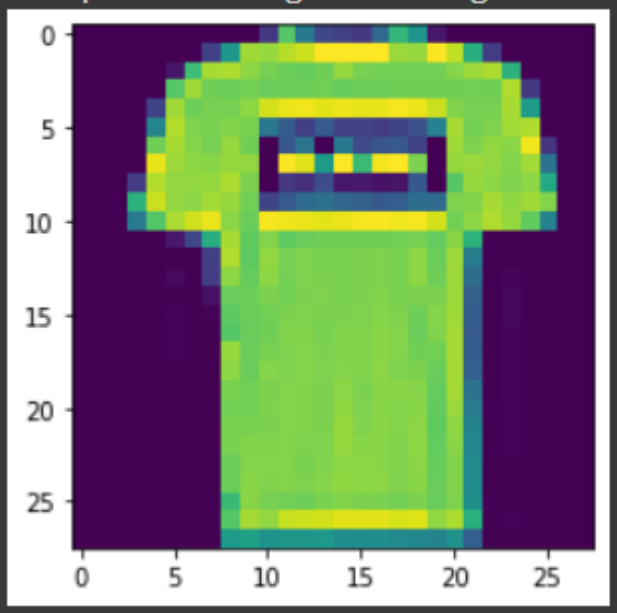
1b) Import the Data + Train Test Split

```
fashion_mnist = keras.datasets.fashion_mnist
(X_train_full, y_train_full), (X_test, y_test) = fashion_mnist.load_data()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-labels-idx1-ubyte.gz
32768/29515 [==============================] - 0s 0us/step
40960/29515 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-images-idx3-ubyte.gz
26427392/26421880 [==============================] - 0s 0us/step
26435584/26421880 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-labels-idx1-ubyte.gz
16384/5148 [==============================================================================================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-images-idx3-ubyte.gz
4423680/4422102 [==============================] - 0s 0us/step
4431872/4422102 [==============================] - 0s 0us/step
```

```
plt.imshow(X_train_full[1])
```

```
<matplotlib.image.AxesImage at 0x7f4f7a400ad0>
```



```
X_train_full[1]
```

```
          0,   0],
       [  0,   0,   0, 164, 235, 214, 211, 220, 216, 201,  52,  71,  89,
         94,  83,  78,  70,  76,  92,  87, 206, 207, 222, 213, 219, 208,
          0,   0],
       [  0,   0,   0, 106, 187, 223, 237, 248, 211, 198, 252, 250, 248,
        245, 248, 252, 253, 250, 252, 239, 201, 212, 225, 215, 193, 113,
          0,   0],
       [  0,   0,   0,   0,   0,  17,  54, 159, 222, 193, 208, 192, 197,
        200, 200, 200, 200, 201, 203, 195, 210, 165,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,  47, 225, 192, 214, 203, 206,
        204, 204, 205, 206, 204, 212, 197, 218, 107,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   1,   6,   0,  46, 212, 195, 212, 202, 206,
        205, 204, 205, 206, 204, 212, 200, 218,  91,   0,   3,   1,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   1,   0,  11, 197, 199, 205, 202, 205,
        206, 204, 205, 207, 204, 205, 205, 218,  77,   0,   5,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   3,   0,   2, 191, 198, 201, 205, 206,
        205, 205, 206, 209, 206, 199, 209, 219,  74,   0,   5,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   2,   0,   0, 188, 197, 200, 207, 207,
        204, 207, 207, 210, 208, 198, 207, 221,  72,   0,   4,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   2,   0,   0, 215, 198, 203, 206, 208,
        205, 207, 207, 210, 208, 200, 202, 222,  75,   0,   4,   0,   0,
```

```
[9] X_train_full[1].shape

    #we see that the handwritten digit 0
    #in x_train[1] is represented by 28 rows x 28 columns of data
    #each represents 0 (black) to 255 (white)
```

```
(28, 28)
```

```
y_train_full[1]

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

#we see that the prediction is 0 which is a T-shirt...
```

```
0
```

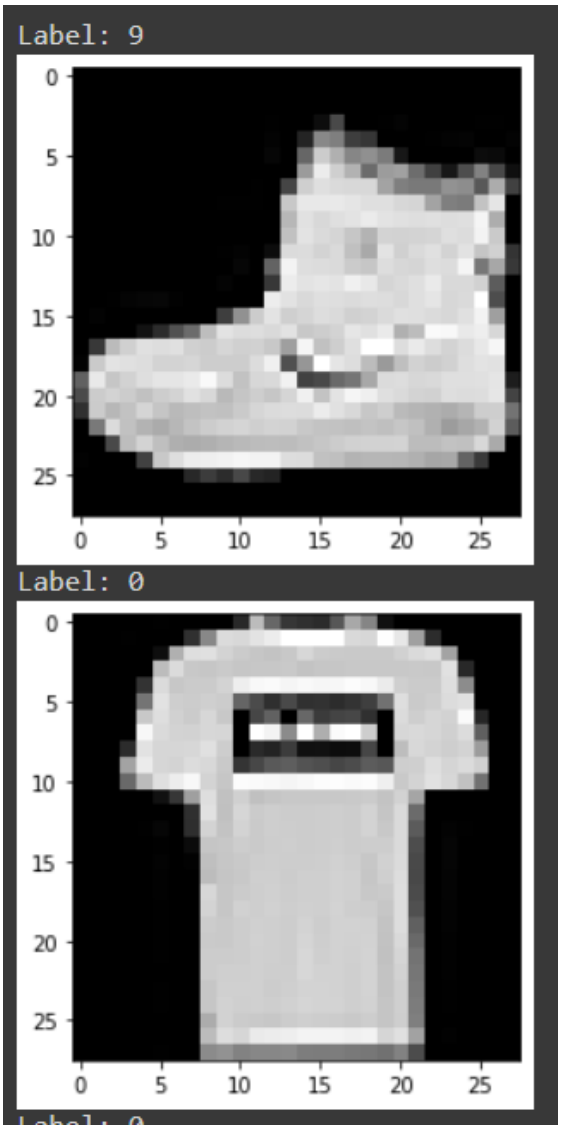
```
[12] display(y_train_full)
```

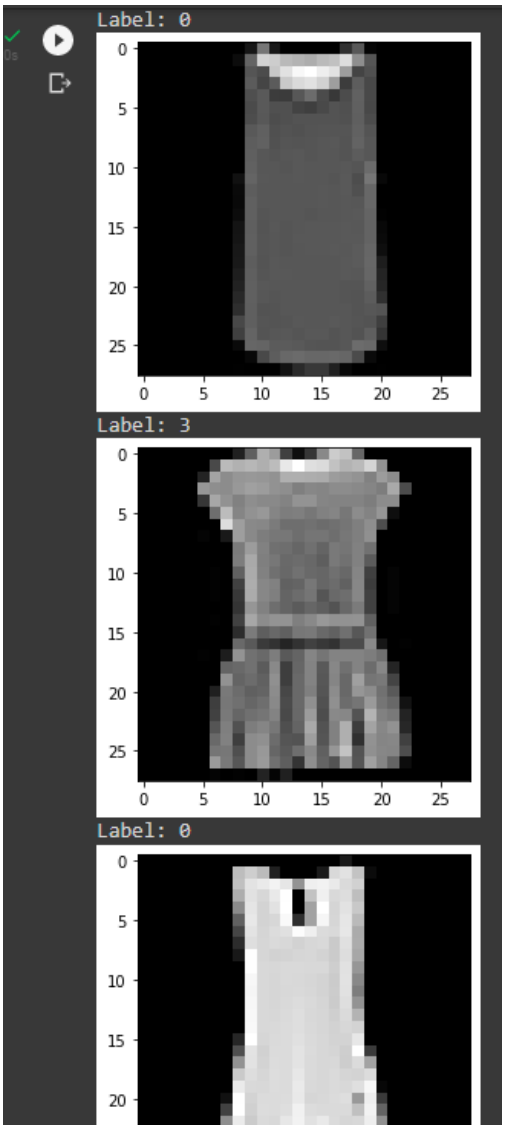
```
array([9, 0, 0, ..., 3, 0, 5], dtype=uint8)
```

```
[14] print(len(np.unique(y_train_full)))
     #to see how many classes there are... 10 classes
```

```
10
```

```
for i in range(5):
    print(f'Label: {y_train_full[i]}')
    plt.imshow(X_train_full[i], cmap='gray')
    plt.show()
```





C. CREATING CLASS NAMES

1c) Creating Class Names

```
[19] class_names = ["T-shirt/top", "Trouser", "Pullover", "Dress", "Coat",
                    "Sandal", "Shirt", "Sneaker", "Bag", "Ankle boot"]
```

D. RESHAPE THE DATA, OR RATHER, ADD IN ADDITIONAL PARAMETER → CHANNELS (RGB)

1d) Reshape the Data, or rather, add in additional Parameter --> Channels (RGB)

```
[20] X_train_full = X_train_full.reshape((60000, 28, 28, 1))
     X_test = X_test.reshape((10000, 28, 28, 1))

     #this means that we convert the x_train to include another parameter called Channel
```

E. DATA NORMALIZATION

1e) Data normalization

We normalize the data dimensions so that they are of approximately the same scale.

```
[21] X_train_n = X_train_full / 255.
     X_test_n = X_test / 255.

     #pictures are from grayscale 0 to 255, so we divide by 255 to
     #normalize from 0 to 1 probability

     #0 is pure black
     #255 (or 1) is pure white
```

F. SPLIT THE DATA INTO TRAIN / VALIDATION / TEST DATASETS

1f) Split the data into train/validation/test datasets

In the earlier step of importing the date, we had 60,000 datasets for training and 10,000 test datasets. Now we further split the training data into train/validation. Here is how each type of dateset is used in deep learning:

- **Training data** — used for training the model (x55,000 rows)
- **Validation data** — used for tuning the hyperparameters and evaluate the models (x5000 rows)
- **Test data** — used to test the model after the model has gone through initial vetting by the validation set. (x10,000 rows)

```
[22] X_valid, X_train = X_train_n[:5000], X_train_n[5000:]
     y_valid, y_train = y_train_full[:5000], y_train_full[5000:]
     X_test = X_test_n
```

```
[30] X_valid.shape
     #5,000 rows of 28 x 28 grayscale images (1 channel)

     (5000, 28, 28, 1)

[31] X_train.shape
     #55,000 rows of 28 x 28 grayscale images (1 channel)

     (55000, 28, 28, 1)

     y_valid.shape
     #5,000 rows of labelled data corresponding to the images

     (5000,)

[28] y_train.shape
     #55,000 rows of labelled data corresponding to the images

     (55000,)

[29] X_test.shape
     #10,000 rows of 28 x 28 grayscale images (1 channel)

     (10000, 28, 28, 1)
```

G. PRESETTING THE RANSOM SEEDS

1g) Presetting the Random Seeds (not entirely needed...)

```
[33] np.random.seed(42)
     tf.random.set_seed(42)

     #this step may be skipped because its not entirely important...
```

Step 2: Build the Model Architecture

```
model = keras.models.Sequential()

#The CNN Layers...
model.add(keras.layers.Conv2D(filters = 32,
                              kernel_size = (3, 3),
                              strides=1,
                              padding='valid',
                              activation='relu',
                              input_shape=(28, 28, 1)))
#Pooling...
model.add(keras.layers.MaxPooling2D((2, 2)))

#The ANN Layers....
model.add(keras.layers.Flatten())
model.add(keras.layers.Dense(300, activation="relu"))
model.add(keras.layers.Dense(100, activation="relu"))
model.add(keras.layers.Dense(10, activation="softmax"))
```

A. SUMMARY OF THE MODEL

2a) Summary of the Model

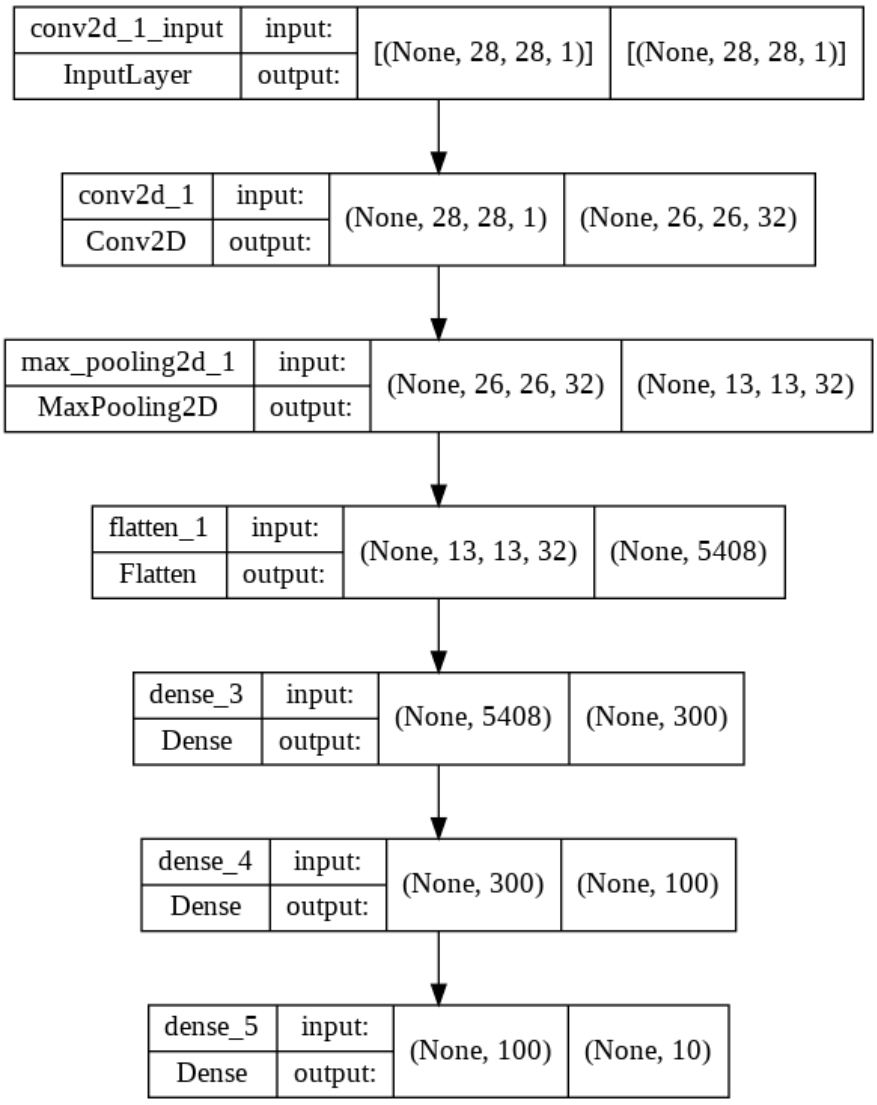
```
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_1 (Conv2D)           (None, 26, 26, 32)        320

 max_pooling2d_1 (MaxPooling  (None, 13, 13, 32)       0
 2D)

 flatten_1 (Flatten)         (None, 5408)              0

 dense_3 (Dense)             (None, 300)               1622700

 dense_4 (Dense)             (None, 100)               30100

 dense_5 (Dense)             (None, 10)                1010

=================================================================
Total params: 1,654,130
Trainable params: 1,654,130
Non-trainable params: 0
_________________________________________________________________
```

B. VISUALIZE THE MODEL

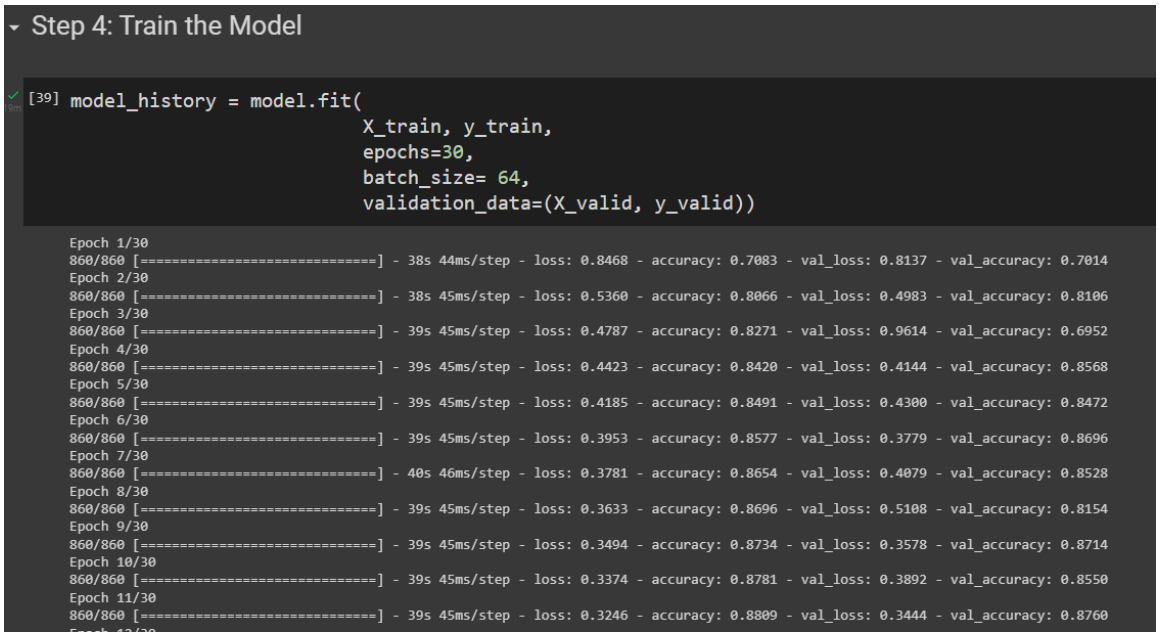
2b) Visualize the Model

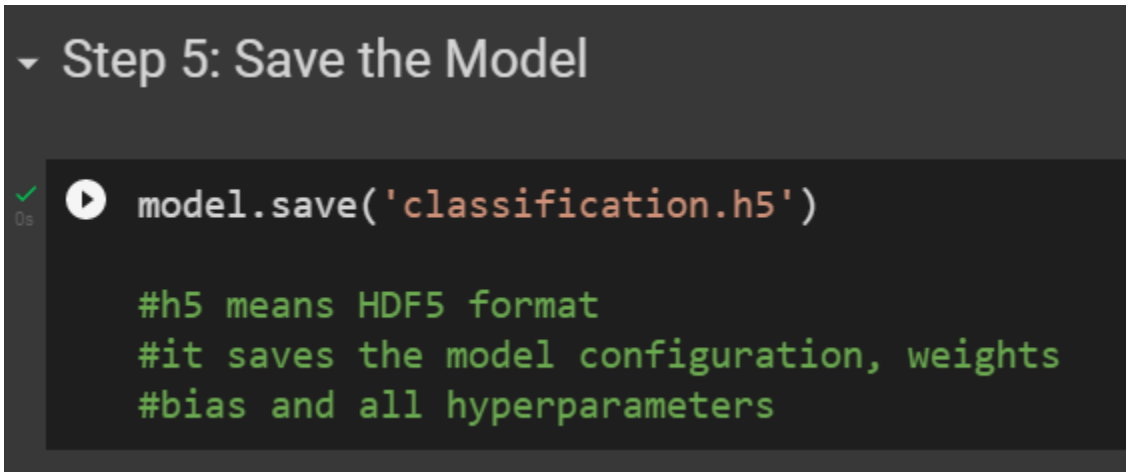
```
import pydot
keras.utils.plot_model(model, 'model.png', show_shapes=True)
```



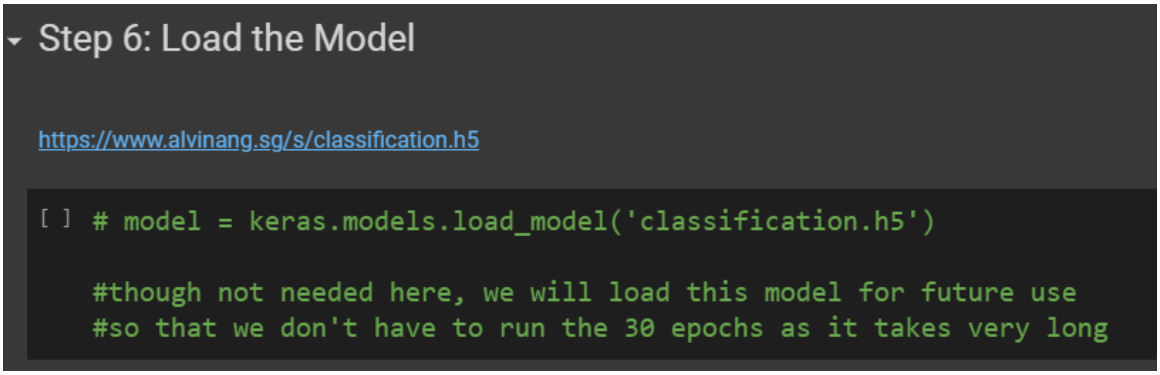
Step 3: Compile the Model

```
[38] model.compile(loss="sparse_categorical_crossentropy",
                   optimizer="sgd",
                   metrics=["accuracy"])

    #sparse_categorical_crossentropy is slower to train
    #but easier to code
    #try converting to categorical_crossentropy for faster processing

    #sparse_categorical_crossentropy dun need "One-Hot Encoding" for
    #both inputs and outputs

    #SGD is for cross entropy --> Classification
    #RMSprop is for Regression
```



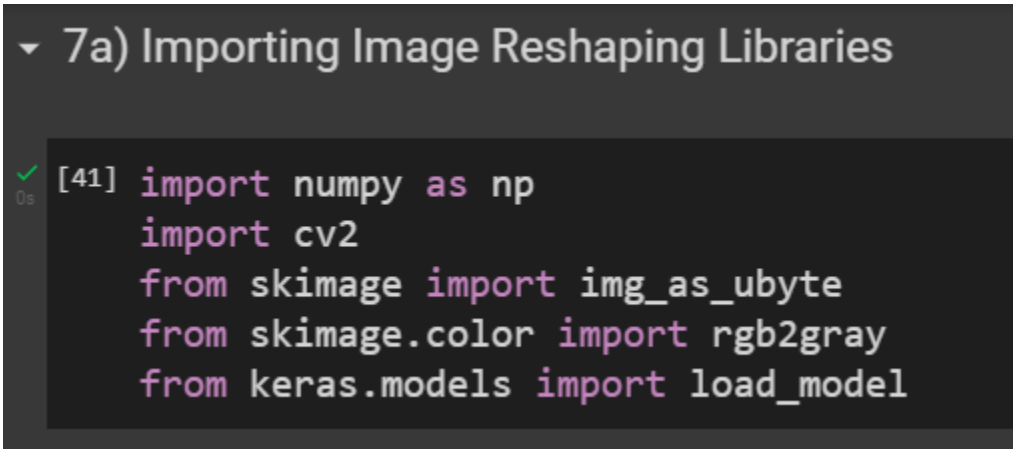


https://www.alvinang.sg/s/classification.h5



VII. STEP 7: RUNNING A PREDICTION

A. IMPORTING IMAGE RESHAPING LIBRARIES



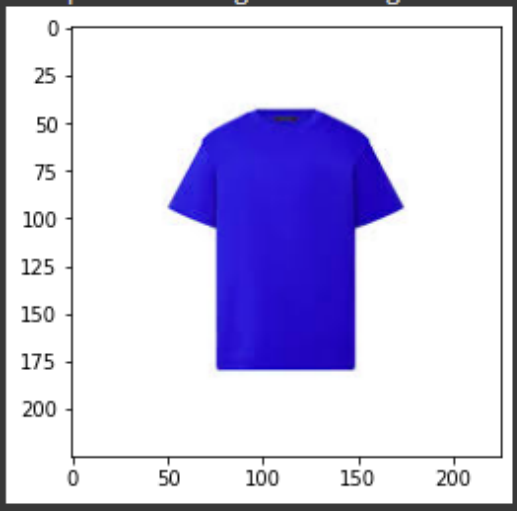
B. IMPORTING AND PREVIEWING THE T SHIRT IMAGE

7b) Importing and Previewing the T Shirt Image

```
[42] shirt = cv2.imread('/content/t-shirt.jpg')
```

```
plt.imshow(shirt)
```

```
<matplotlib.image.AxesImage at 0x7f4f79e39750>
```



C. RE-COLORING / RE-SHAPING / RE-SIZING

7c) Re-Coloring / Re-Shaping / Re-Sizing

```
[44] shirt_gray = rgb2gray(shirt)
     shirt_gray_u8 = img_as_ubyte(shirt_gray)
```

```
[45] (thresh, im_binary) = cv2.threshold(shirt_gray_u8, 128, 255, cv2.THRESH_BINARY | cv2.THRESH_OTSU)
```

```
[46] img_resized = cv2.resize(im_binary,(28,28))
```

```
[47] im_gray_invert = 255 - img_resized
```

```
[48] plt.imshow(im_gray_invert)
```

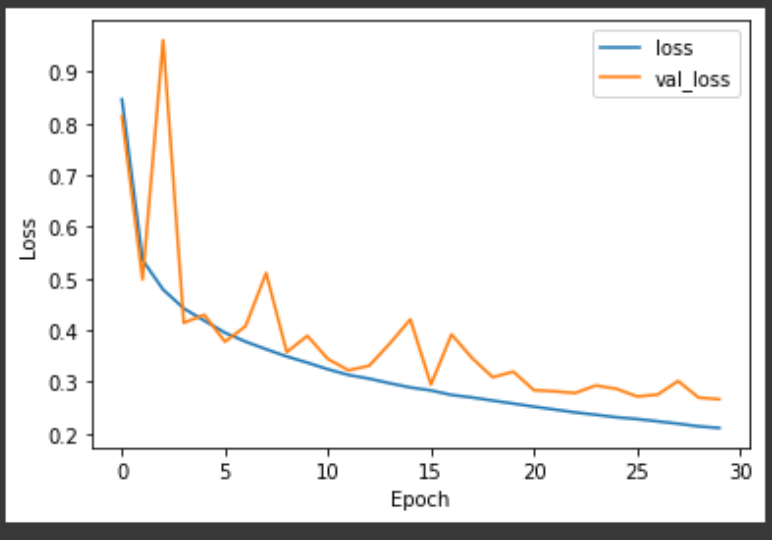
```
<matplotlib.image.AxesImage at 0x7f4f79c37bd0>
```


```
[49] im_final = im_gray_invert.reshape(1,28,28,1)
```

Step 8: Visualize the Loss or Error

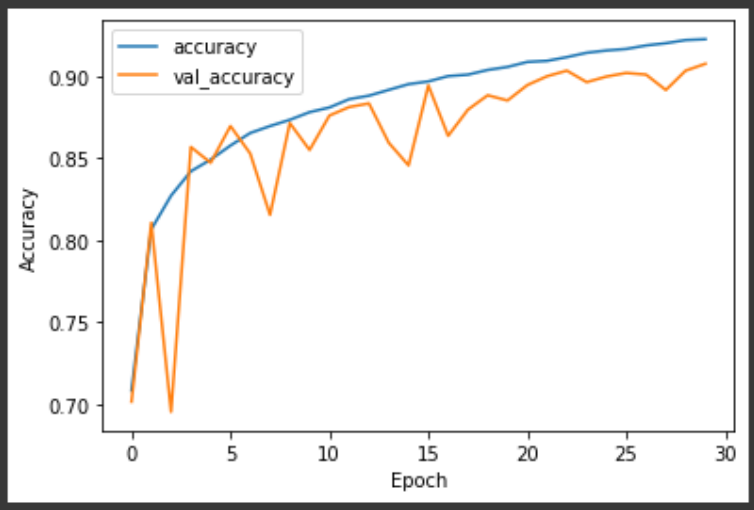
```
[54] loss = model_history.history['loss']
     val_loss = model_history.history['val_loss']
     acc = model_history.history['accuracy']
     val_acc = model_history.history['val_accuracy']
     epoch = range(len(loss))
```

```
import matplotlib.pyplot as plt

plt.plot(epoch, loss, label = "loss")
plt.plot(epoch, val_loss, label = 'val_loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.show()
```

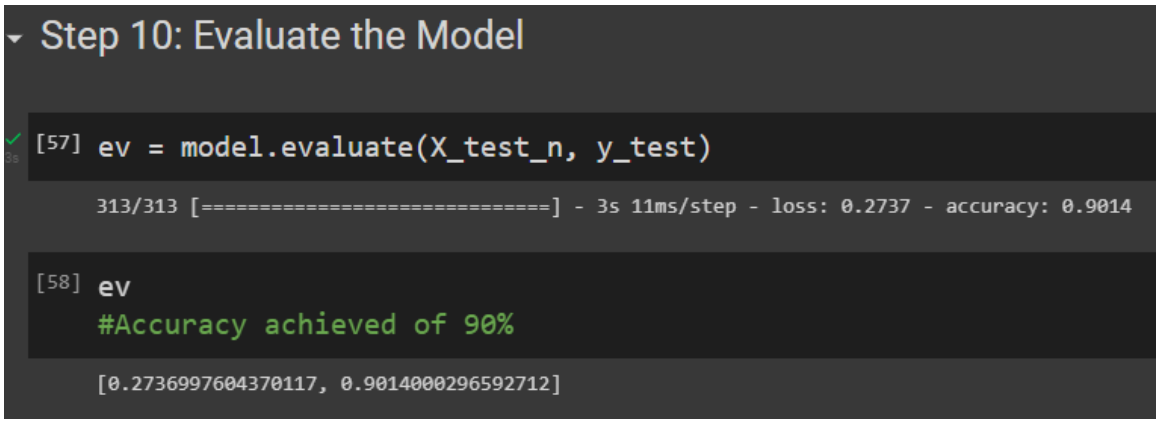


Step 9: Visualize the Accuracy

```
plt.plot(epoch, acc, label = 'accuracy')
plt.plot(epoch, val_acc, label = 'val_accuracy')
plt.xlabel("Epoch")
plt.ylabel('Accuracy')
plt.legend()
plt.show()
```



X. STEP 10: EVALUATE THE MODEL



ABOUT DR. ALVIN ANG

Dr. Alvin Ang earned his Ph.D., Masters and Bachelor degrees from NTU, Singapore. He is a scientist, entrepreneur, as well as a personal/business advisor. More about him at www.AlvinAng.sg.