image_classification_with_neural_networks

December 23, 2025

1 Classification with Neural Networks

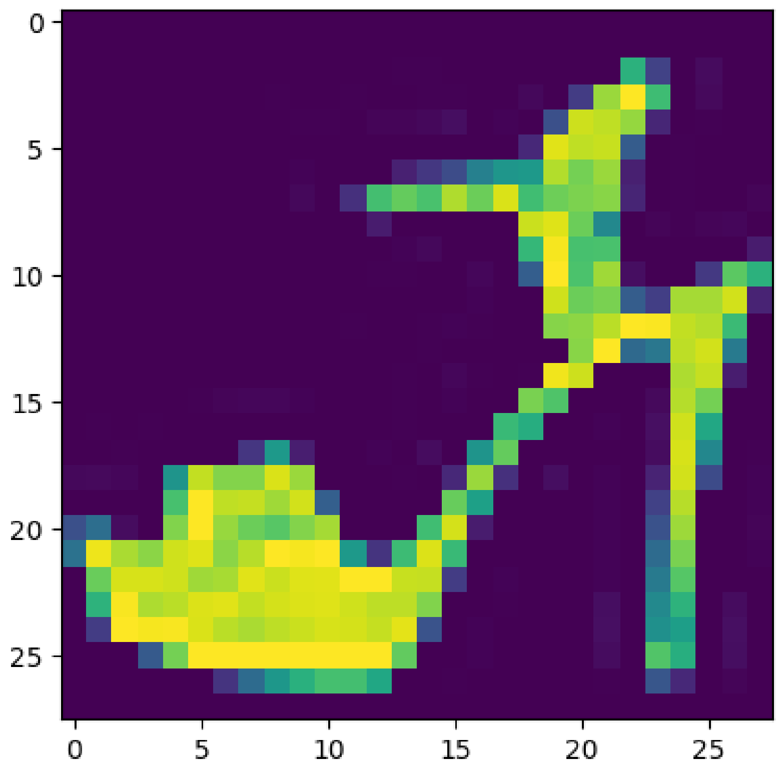
[1]:
```python
import tensorflow as tf
from tensorflow import keras
import numpy as np
import matplotlib.pyplot as plt
fashion = keras.datasets.fashion_mnist
(xtrain, ytrain), (xtest, ytest) = fashion.load_data()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-
datasets/train-labels-idx1-ubyte.gz
29515/29515             0s 1us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-
datasets/train-images-idx3-ubyte.gz
26421880/26421880             4s
0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-
datasets/t10k-labels-idx1-ubyte.gz
5148/5148             0s 3us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-
datasets/t10k-images-idx3-ubyte.gz
4422102/4422102             2s
0us/step
```

[2]:
```python
imgIndex = 9
image = xtrain[imgIndex]
print("Image Label :",ytrain[imgIndex])
plt.imshow(image)
```

```
Image Label : 5
```

[2]:
```
<matplotlib.image.AxesImage at 0x25700cc7750>
```



[3]:
```
print(xtrain.shape)
print(xtest.shape)
```

```
(60000, 28, 28)
(10000, 28, 28)
```

[4]:
```
model = keras.models.Sequential([
    keras.layers.Flatten(input_shape=[28, 28]),
    keras.layers.Dense(300, activation="relu"),
    keras.layers.Dense(100, activation="relu"),
    keras.layers.Dense(10, activation="relu"),
])
print(model.summary())
```

```
C:\Users\USER\miniconda3\envs\ds4b\Lib\site-
packages\keras\src\layers\reshaping\flatten.py:37: UserWarning: Do not pass an
`input_shape`/`input_dim` argument to a layer. When using Sequential models,
prefer using an `Input(shape)` object as the first layer in the model instead.
  super().__init__(**kwargs)
```

```
Model: "sequential"
```

```
 Layer (type)                                Output Shape                            ␣
↪Param #

 flatten (Flatten)                           (None, 784)                                 ␣
↪  0

 dense (Dense)                               (None, 300)                             ␣
↪235,500

 dense_1 (Dense)                             (None, 100)                              ␣
↪30,100

 dense_2 (Dense)                             (None, 10)                                ␣
↪1,010



 Total params: 266,610 (1.02 MB)


 Trainable params: 266,610 (1.02 MB)


 Non-trainable params: 0 (0.00 B)

None
```

[5]:
```
xvalid, xtrain = xtrain[:5000]/255.0, xtrain[:5000]/255.0
yvalid, ytrain = ytrain[:5000]/255.0, ytrain[:5000]
```

[6]:
```
model.compile(loss = "sparse_categorical_crossentropy",
             optimizer = "sgd",
             metrics=["accuracy"])
history = model.fit(xtrain, ytrain, epochs=30,
                   validation_data=(xvalid, yvalid))
```

```
Epoch 1/30
157/157            5s 16ms/step -
accuracy: 0.2554 - loss: 3.3712 - val_accuracy: 0.0000e+00 - val_loss: 18.0639
Epoch 2/30
157/157            2s 12ms/step -
accuracy: 0.0976 - loss: 6.8426 - val_accuracy: 0.0000e+00 - val_loss: 18.0639
Epoch 3/30
157/157            2s 12ms/step -
accuracy: 0.0976 - loss: 6.8425 - val_accuracy: 0.0000e+00 - val_loss: 18.0635
Epoch 4/30
157/157            2s 11ms/step -
accuracy: 0.0976 - loss: 8.0733 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 5/30
```

```
157/157              2s 11ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 6/30
157/157              2s 11ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 7/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 8/30
157/157              2s 12ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 9/30
157/157              3s 17ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 10/30
157/157              2s 12ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 11/30
157/157              2s 11ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 12/30
157/157              2s 15ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 13/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 14/30
157/157              2s 11ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 15/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 16/30
157/157              3s 22ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 17/30
157/157              2s 12ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 18/30
157/157              2s 11ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 19/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 20/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 21/30
```

```
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 22/30
157/157              2s 12ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 23/30
157/157              2s 14ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 24/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 25/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 26/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 27/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 28/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 29/30
157/157              2s 10ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
Epoch 30/30
157/157              2s 11ms/step -
accuracy: 0.0976 - loss: 8.2680 - val_accuracy: 0.0000e+00 - val_loss: 17.9099
```

[7]:
```
new = xtest[:5]
predictions = model.predict(new)
print(predictions)
```

```
1/1              0s 177ms/step
[[     0.           0.        1744.8864   2466.2341  37160.547    1103.994
    3765.871    1593.8174      0.           0.    ]
 [     0.           0.        6121.2056   8705.096  127639.47     3077.999
   13245.684    5246.368      0.           0.    ]
 [     0.           0.        4294.097    6181.812   92248.51     2243.1167
    9485.057    3808.6047      0.           0.    ]
 [     0.           0.        2969.3694   4282.6733  63950.645    1558.9495
    6552.636    2695.8813      0.           0.    ]
 [     0.           0.        3858.3806   5489.216   81062.125    1965.4791
    8395.744    3368.7114      0.           0.    ]]
```

[ ]: