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Initialization

load all needed libraries and functions, check the previos tutorial how to correctly load keras and other modules

In [1]:

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import tensorflow as tf
import os
import cv2
from tqdm import tqdm
```

importing the libraries used in the code.

Load dataset & Plot a subset

load your dataset and show a plot of the subset of your data

In [2]:

```
mnist = tf.keras.datasets.fashion_mnist
(x_train, y_train),(x_test, y_test) = mnist.load_data()
print(x_train[0])
categories = ["T-shirt_top", "trouser","pullover","dress","coat","sandal","shirt","sneak
print(y_train[0])
plt.imshow(x_train[0], cmap=plt.cm.binary)
plt.show()
```

```
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  255 255 221 234 221 211 220 232 246   0]
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    0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
    0   0   0   0   0   0   0   0   0   0]]
9
```
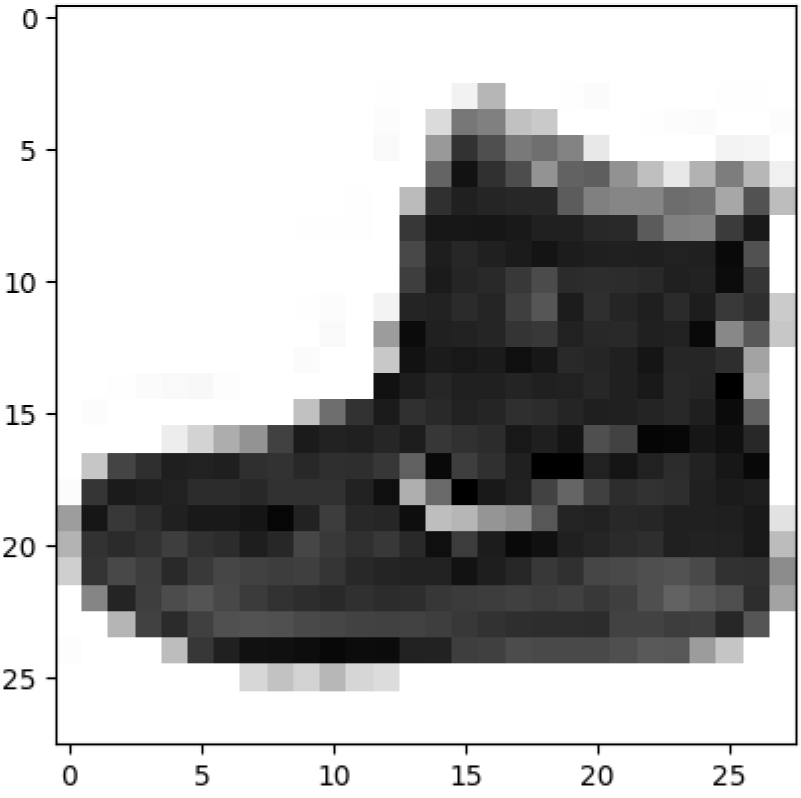
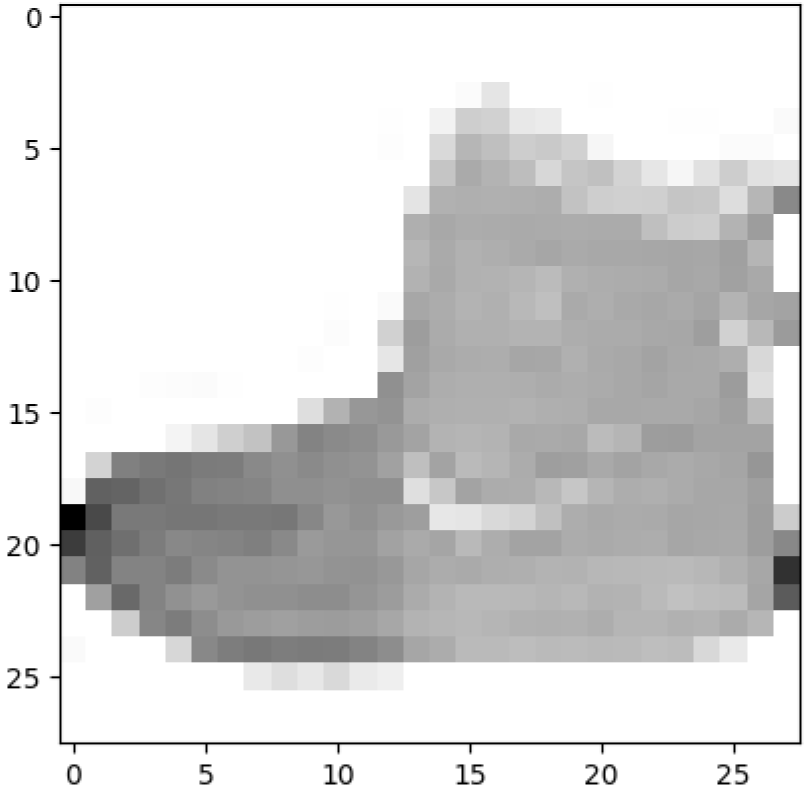



importing the images as a matrix and plotting the not yet normalized data.

Prepare Data

pre-process your raw input data... rescale... normalize....

```
In [3]: x_train = tf.keras.utils.normalize(x_train, axis=1)

        plt.imshow(x_train[0], cmap=plt.cm.binary)
        plt.show()
        print(x_train[0])


        x_test = tf.keras.utils.normalize(x_test, axis=1)

        plt.imshow(x_test[0], cmap=plt.cm.binary)
        plt.show()
        print(x_test[0])
```



```
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  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
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  0.         0.         0.         0.        ]
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  0.         0.         0.         0.        ]
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  0.         0.00112628 0.00124281 0.        ]
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```

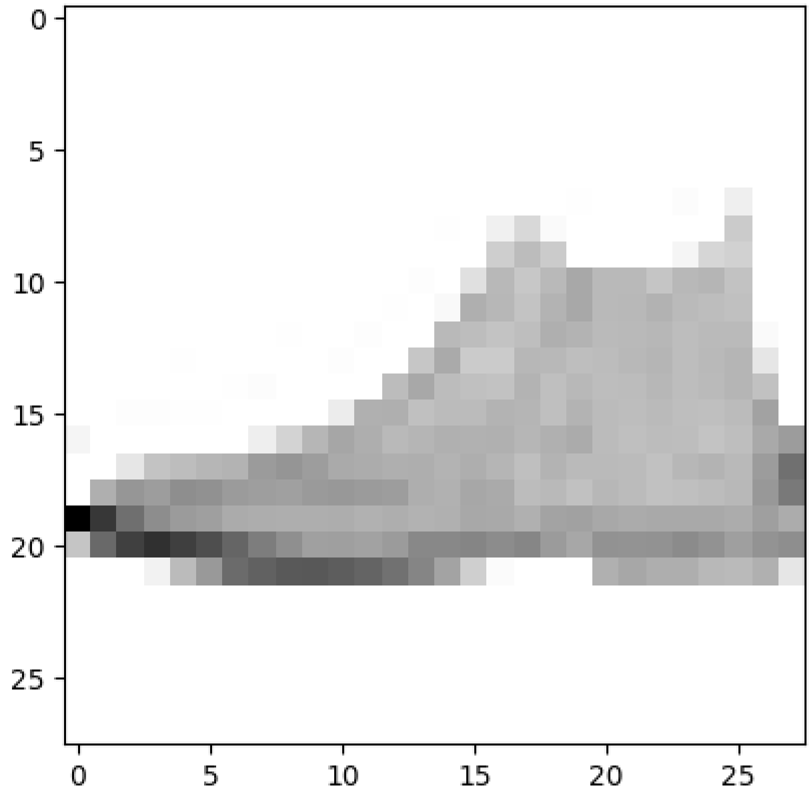

```
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  0.24697129 0.26099001 0.35691129 0.        ]
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 [0.         0.30700165 0.39990587 0.37590168 0.43211602 0.4194466
  0.38179739 0.3709991  0.36392952 0.38533178 0.39470816 0.38204056
  0.37294761 0.30907708 0.29715998 0.33686564 0.32669967 0.25824646
  0.26996424 0.23699674 0.2749735  0.26218329 0.2388063  0.24392211
  0.25705175 0.27102809 0.39300344 0.51115707]
 [0.97400879 0.7629894  0.548807   0.43437527 0.38150784 0.36793562
  0.32332392 0.31567467 0.31013124 0.30947907 0.31576653 0.29776691
  0.310355   0.29435912 0.30183966 0.33240384 0.33094252 0.30158853
  0.34657571 0.36023505 0.33268398 0.32044625 0.32835866 0.33053214
  0.33097513 0.31619944 0.368942   0.31726991]
 [0.22263058 0.56885601 0.72748834 0.78521684 0.73187218 0.67700153
  0.58817436 0.49791984 0.42722161 0.36409302 0.36839428 0.35675846
  0.38077169 0.45380364 0.45626926 0.46625774 0.44125669 0.46050943
  0.38123328 0.33558739 0.41585498 0.40784068 0.41625265 0.44365544
  0.41497897 0.36806284 0.41305464 0.4318396 ]
 [0.         0.         0.         0.05012022 0.26082679 0.39001175
  0.56409705 0.60205994 0.6297563  0.63716279 0.61691423 0.58991557
  0.54246925 0.46606861 0.35097635 0.18293366 0.01697141 0.
  0.         0.         0.30213137 0.3366304  0.31177489 0.30932152
  0.27217244 0.26433604 0.30277306 0.09694358]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]]
```

all values scaled between 0 and 1. thus the highest value is scaled down to 1. this is why the images is a lighter color than before

Define your Model

Define your neural network architecture here

- Describe the implemented network architecture.
- How many parameters does this network have, and where in the network are these located?

In [4]:

```
model = tf.keras.models.Sequential()
model.add(tf.keras.layers.Input(shape=(28, 28,1)))
model.add(tf.keras.layers.Conv2D(32, (3, 3), activation=tf.nn.relu))
model.add(tf.keras.layers.MaxPooling2D((2, 2)))
model.add(tf.keras.layers.Conv2D(64, (3, 3), activation=tf.nn.relu))
model.add(tf.keras.layers.MaxPooling2D((2, 2)))
model.add(tf.keras.layers.Conv2D(64, (3, 3), activation=tf.nn.relu))
model.add(tf.keras.layers.MaxPooling2D((2, 2)))

model.add(tf.keras.layers.Flatten())
model.add(tf.keras.layers.Dense(128, activation=tf.nn.relu))
model.add(tf.keras.layers.Dense(128, activation=tf.nn.relu))
model.add(tf.keras.layers.Dense(10, activation=tf.nn.softmax))

model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d (Conv2D)             (None, 26, 26, 32)        320       
                                                                 
 max_pooling2d (MaxPooling2D  (None, 13, 13, 32)       0         
 )                                                               
                                                                 
 conv2d_1 (Conv2D)           (None, 11, 11, 64)        18496     
                                                                 
 max_pooling2d_1 (MaxPooling  (None, 5, 5, 64)         0         
 2D)                                                             
                                                                 
 conv2d_2 (Conv2D)           (None, 3, 3, 64)          36928     
                                                                 
 max_pooling2d_2 (MaxPooling  (None, 1, 1, 64)         0         
 2D)                                                             
                                                                 
 flatten (Flatten)           (None, 64)                0         
                                                                 
 dense (Dense)               (None, 128)               8320      
                                                                 
 dense_1 (Dense)             (None, 128)               16512     
                                                                 
 dense_2 (Dense)             (None, 10)                1290      
                                                                 
=================================================================
Total params: 81,866
Trainable params: 81,866
Non-trainable params: 0
_________________________________________________________________
```

the model has 11 layers, 9 of which are hidden. the input layer has 28*28*1=784 neurons. the output has 10 neurons, 1 for each class. the hidden layers consist of 3 convolution layers, each of them followed by a pooling layer. the output of these layers are run trough 2 fully connected layers of 128 neurons each.

Fit the Model

Fitting the model is the time consuming part, this depend on the complexity of the model and the amount of training data. In the fitting process the model is first build up in memory with all the tunable parameters and intercomnnects (with random start values). This is also the limitation of some systems, all these parameters are stored in memory (or when not fitting in a swap file)

TIP: do not start the first time with training a lot of epochs, first see if this and all following steps in your system work and when you are sure that all works train your final model. You can also monitor the Jetson CPU/GPU/Memory performance during this process (see Tips & Tricks)

- Explain what hyperparameters are available and what they do.
- Which hyperparameter result in better training results?

In [5]:
```
model.compile(optimizer='SGD',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

history = model.fit(x_train, y_train, epochs=100)
```

```
Epoch 1/100
1875/1875 [==============================] - 9s 4ms/step - loss: 1.6481 - accuracy: 0.45
```

```
01
Epoch 2/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.7679 - accuracy: 0.70
10
Epoch 3/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.6466 - accuracy: 0.74
95
Epoch 4/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.5830 - accuracy: 0.77
84
Epoch 5/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.5408 - accuracy: 0.79
78
Epoch 6/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.5076 - accuracy: 0.81
19
Epoch 7/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.4792 - accuracy: 0.82
22
Epoch 8/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.4585 - accuracy: 0.82
90
Epoch 9/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.4390 - accuracy: 0.83
85
Epoch 10/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.4236 - accuracy: 0.84
37
Epoch 11/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.4113 - accuracy: 0.84
73
Epoch 12/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.4004 - accuracy: 0.85
10
Epoch 13/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3899 - accuracy: 0.85
47
Epoch 14/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.3814 - accuracy: 0.85
75
Epoch 15/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3735 - accuracy: 0.85
98
Epoch 16/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.3655 - accuracy: 0.86
44
Epoch 17/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.3584 - accuracy: 0.86
68
Epoch 18/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3516 - accuracy: 0.86
88
Epoch 19/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3454 - accuracy: 0.87
19
Epoch 20/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3404 - accuracy: 0.87
32
Epoch 21/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3328 - accuracy: 0.87
66
Epoch 22/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.3290 - accuracy: 0.87
75
Epoch 23/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3241 - accuracy: 0.87
```

```
86
Epoch 24/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3188 - accuracy: 0.88
03
Epoch 25/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.3144 - accuracy: 0.88
29
Epoch 26/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3103 - accuracy: 0.88
37
Epoch 27/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.3060 - accuracy: 0.88
53
Epoch 28/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.3013 - accuracy: 0.88
78
Epoch 29/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2991 - accuracy: 0.88
84
Epoch 30/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2936 - accuracy: 0.88
86
Epoch 31/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2890 - accuracy: 0.89
19
Epoch 32/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2854 - accuracy: 0.89
40
Epoch 33/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2826 - accuracy: 0.89
47
Epoch 34/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2792 - accuracy: 0.89
49
Epoch 35/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2752 - accuracy: 0.89
58
Epoch 36/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2721 - accuracy: 0.89
77
Epoch 37/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2681 - accuracy: 0.89
89
Epoch 38/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2657 - accuracy: 0.90
00
Epoch 39/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2617 - accuracy: 0.90
19
Epoch 40/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2596 - accuracy: 0.90
30
Epoch 41/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2563 - accuracy: 0.90
35
Epoch 42/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2528 - accuracy: 0.90
53
Epoch 43/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2495 - accuracy: 0.90
63
Epoch 44/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2470 - accuracy: 0.90
70
Epoch 45/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2429 - accuracy: 0.90
```

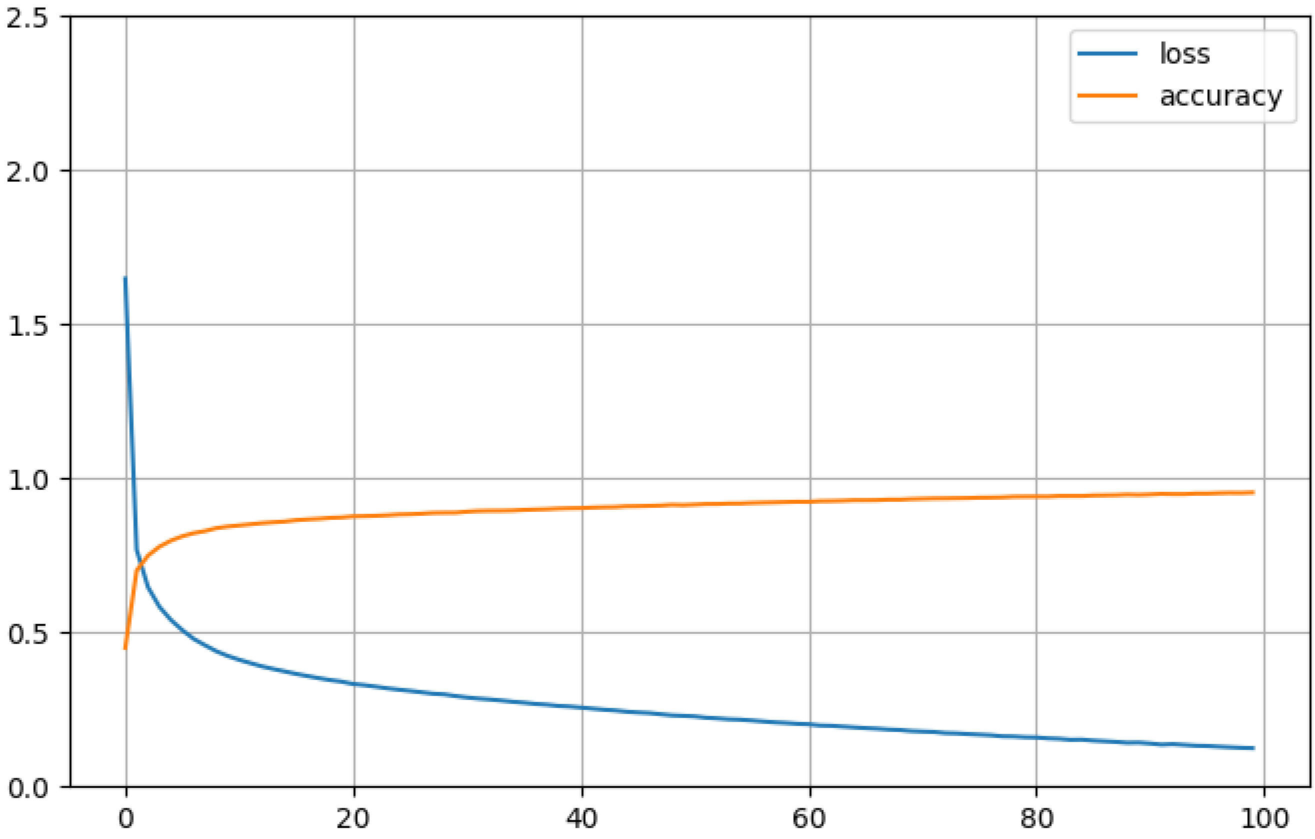
```
94
Epoch 46/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2404 - accuracy: 0.90
98
Epoch 47/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2385 - accuracy: 0.91
08
Epoch 48/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2347 - accuracy: 0.91
17
Epoch 49/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2310 - accuracy: 0.91
42
Epoch 50/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2294 - accuracy: 0.91
32
Epoch 51/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2275 - accuracy: 0.91
48
Epoch 52/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2233 - accuracy: 0.91
67
Epoch 53/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2212 - accuracy: 0.91
68
Epoch 54/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2183 - accuracy: 0.91
83
Epoch 55/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2171 - accuracy: 0.91
84
Epoch 56/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2144 - accuracy: 0.92
01
Epoch 57/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2112 - accuracy: 0.92
12
Epoch 58/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2084 - accuracy: 0.92
21
Epoch 59/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.2064 - accuracy: 0.92
32
Epoch 60/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2036 - accuracy: 0.92
41
Epoch 61/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.2021 - accuracy: 0.92
38
Epoch 62/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1981 - accuracy: 0.92
61
Epoch 63/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1972 - accuracy: 0.92
65
Epoch 64/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1946 - accuracy: 0.92
75
Epoch 65/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.1920 - accuracy: 0.92
91
Epoch 66/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1896 - accuracy: 0.92
91
Epoch 67/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.1878 - accuracy: 0.92
```

```
94
Epoch 68/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1850 - accuracy: 0.93
10
Epoch 69/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.1836 - accuracy: 0.93
09
Epoch 70/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1802 - accuracy: 0.93
27
Epoch 71/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.1785 - accuracy: 0.93
38
Epoch 72/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1772 - accuracy: 0.93
48
Epoch 73/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.1735 - accuracy: 0.93
51
Epoch 74/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1725 - accuracy: 0.93
57
Epoch 75/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1702 - accuracy: 0.93
62
Epoch 76/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1684 - accuracy: 0.93
74
Epoch 77/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1666 - accuracy: 0.93
77
Epoch 78/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1630 - accuracy: 0.93
85
Epoch 79/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1623 - accuracy: 0.94
04
Epoch 80/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1600 - accuracy: 0.94
08
Epoch 81/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1592 - accuracy: 0.94
10
Epoch 82/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1564 - accuracy: 0.94
09
Epoch 83/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1549 - accuracy: 0.94
28
Epoch 84/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1517 - accuracy: 0.94
28
Epoch 85/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1522 - accuracy: 0.94
28
Epoch 86/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1490 - accuracy: 0.94
45
Epoch 87/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1469 - accuracy: 0.94
51
Epoch 88/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1449 - accuracy: 0.94
57
Epoch 89/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1420 - accuracy: 0.94
```

```
74
Epoch 90/100
1875/1875 [==============================] - 7s 4ms/step - loss: 0.1426 - accuracy: 0.94
64
Epoch 91/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1397 - accuracy: 0.94
78
Epoch 92/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1360 - accuracy: 0.94
96
Epoch 93/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1376 - accuracy: 0.94
89
Epoch 94/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1351 - accuracy: 0.94
89
Epoch 95/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1326 - accuracy: 0.95
07
Epoch 96/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1316 - accuracy: 0.95
06
Epoch 97/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1294 - accuracy: 0.95
20
Epoch 98/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1275 - accuracy: 0.95
29
Epoch 99/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1257 - accuracy: 0.95
26
Epoch 100/100
1875/1875 [==============================] - 8s 4ms/step - loss: 0.1245 - accuracy: 0.95
40
```

In [6]:

```
pd.DataFrame(history.history).plot(figsize=(8, 5))
plt.grid(True)
plt.gca().set_ylim(0, 2.5)
plt.show()
```



Here the optimiser is chosen and model is trained with 100 iterations.

Evaluate Model

Show the model accuracy after the training process ...

- What is the final accuracy of the trained Network?

In [7]:
```
val_loss, val_acc = model.evaluate(x_test, y_test)
print(val_loss)
print(val_acc)
```

```
313/313 [==============================] - 1s 3ms/step - loss: 0.4315 - accuracy: 0.8834
0.4314877986907959
0.883400022983551
```

Here the model is tested with the given test data. The accuracy is shown

Save model

Save the model for later usage

In [8]:
```
model.save('Ass2A')
new_model = tf.keras.models.load_model('Ass2A')
```

```
WARNING:absl:Found untraced functions such as _jit_compiled_convolution_op, _jit_compile
d_convolution_op, _jit_compiled_convolution_op while saving (showing 3 of 3). These func
tions will not be directly callable after loading.
INFO:tensorflow:Assets written to: Ass2A\assets
INFO:tensorflow:Assets written to: Ass2A\assets
```

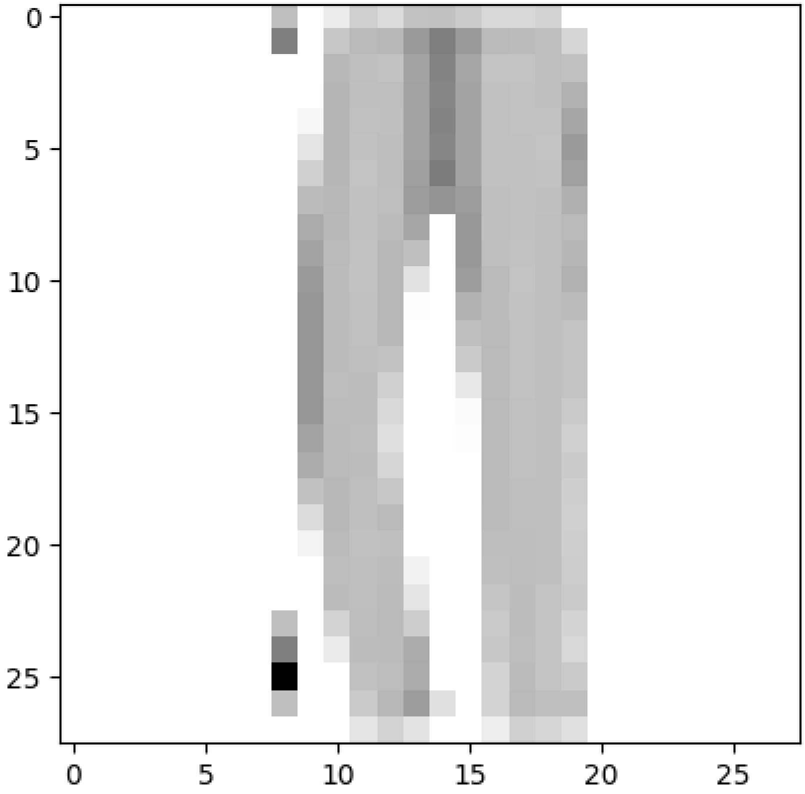
Evaluate Final Model

After training and saving the model you can deploy this model on any given input image. You can start a new application in where you import this model and apply it on any given imput images, so you can just load the model and don't need the timeconsuming training anymore.

In [9]:

```
predictions = new_model.predict([x_test])

plt.imshow(x_test[2], cmap=plt.cm.binary)
plt.show()
print("prediction =", categories[np.argmax(predictions[2])])
```

```
313/313 [==============================] - 1s 2ms/step
```



```
prediction = trouser
```

Here we predict one image to double check the model. this image is out of the test data. The model classifies the image as trouser. as seen by the image this is correct.

Make Prediction

We can use our saved model to make a prediction on new images that are not trained on... make sure the input images receive the same pre-processing as the images you trained on.

So fetch some images from the internet (similar classes, but not from your dataset), prepare them to fit your network and classify them. Do this for **10 images per class** and show the results!

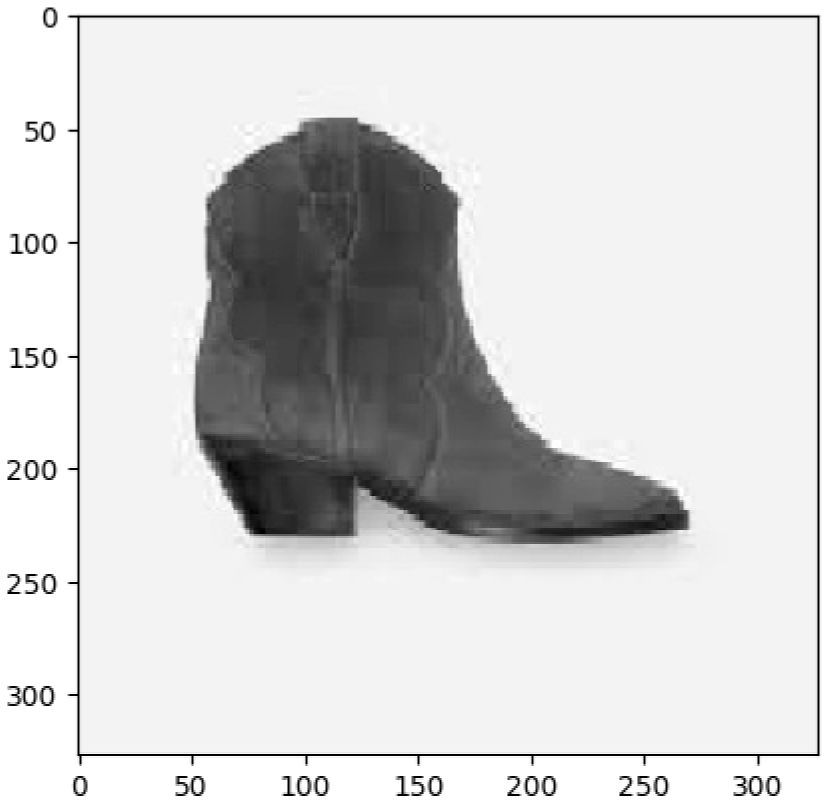
- How good is the detection on you real dataset? (show some statistics)

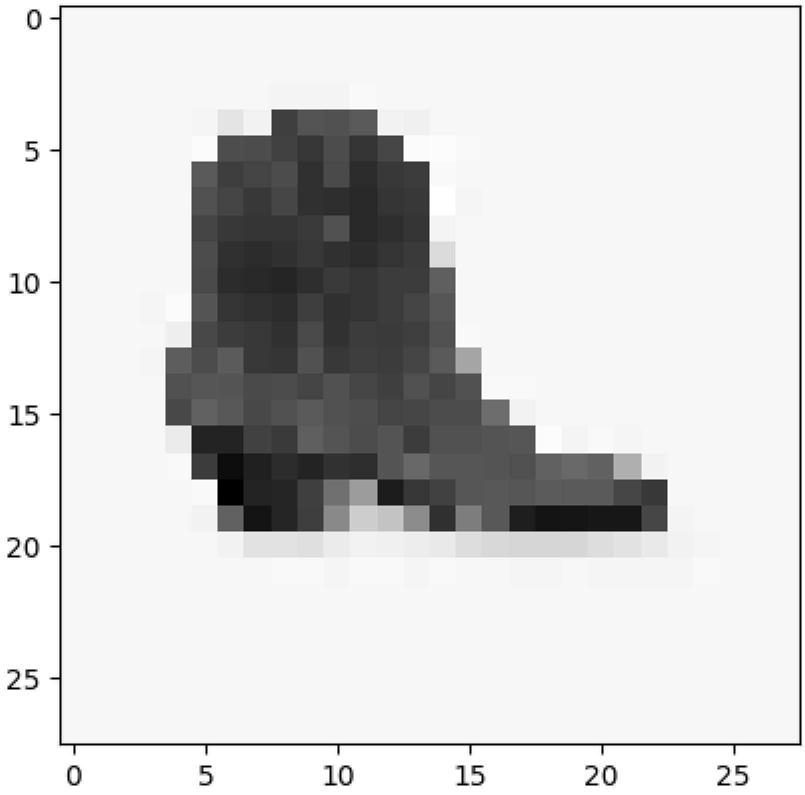
In [10]:

```
#yosha
#DATADIR = "C:/Users/yosha19/OneDrive - Office 365 Fontys/General/Ass2A/plaatjes"

#kasper
DATADIR = "C:/Users/mobie/OneDrive - Office 365 Fontys/General - AIS zooi/Ass2A/plaatjes
```

```
CATEGORIES = ["0. T-shirt_top", "1. trouser","2. pullover","3. dress","4. coat","5. sand

IMG_SIZE = 28

test_data = []

def create_test_data():
    for category in CATEGORIES:

        path = os.path.join(DATADIR,category)
        class_num = CATEGORIES.index(category)

        for img in tqdm(os.listdir(path)):
            try:
                img_array = cv2.imread(os.path.join(path,img) ,cv2.IMREAD_GRAYSCALE)
                new_array = cv2.resize(img_array, (IMG_SIZE, IMG_SIZE))
                test_data.append([new_array, class_num])

            except Exception as e:
                pass


    plt.imshow(img_array, cmap='gray')
    plt.show()

    plt.imshow(new_array, cmap='gray')
    plt.show()

create_test_data()
```

```
100%|██████████| 10/10 [00:00<00:00, 1252.93it/s]
100%|██████████| 10/10 [00:00<00:00, 1676.45it/s]
100%|██████████| 10/10 [00:00<00:00, 1253.49it/s]
100%|██████████| 10/10 [00:00<00:00, 1997.10it/s]
100%|██████████| 10/10 [00:00<00:00, 1253.64it/s]
100%|██████████| 10/10 [00:00<00:00, 646.32it/s]
100%|██████████| 10/10 [00:00<00:00, 1432.24it/s]
100%|██████████| 10/10 [00:00<00:00, 2004.64it/s]
100%|██████████| 10/10 [00:00<00:00, 1432.97it/s]
100%|██████████| 10/10 [00:00<00:00, 2005.40it/s]
```





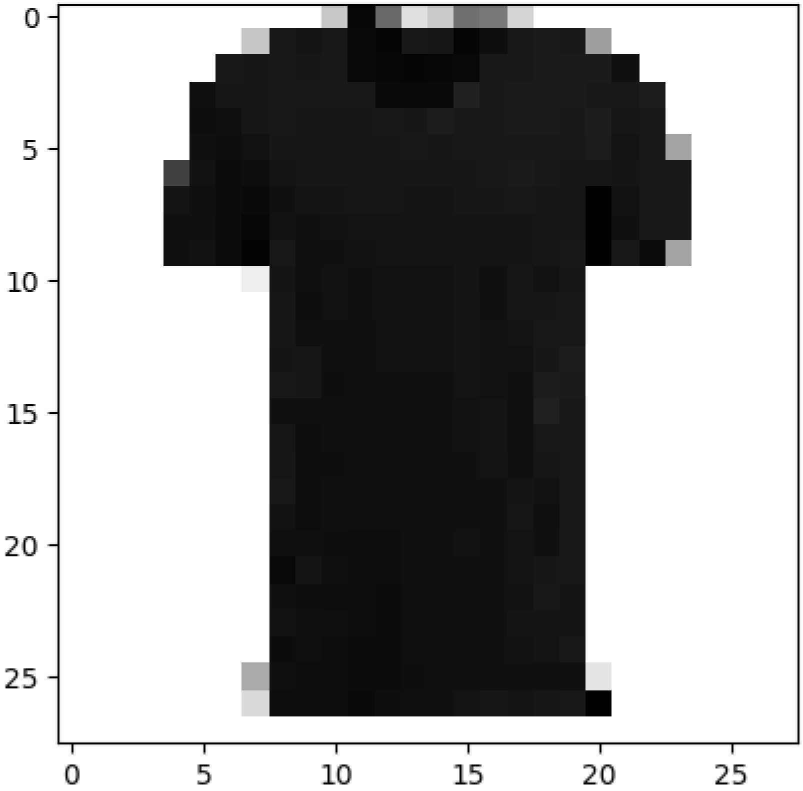
Here we import our own data set. An for loop iterates trough all images and resizes them and adds them to an array. The before and after pictures of the resize are shown.

In [11]:

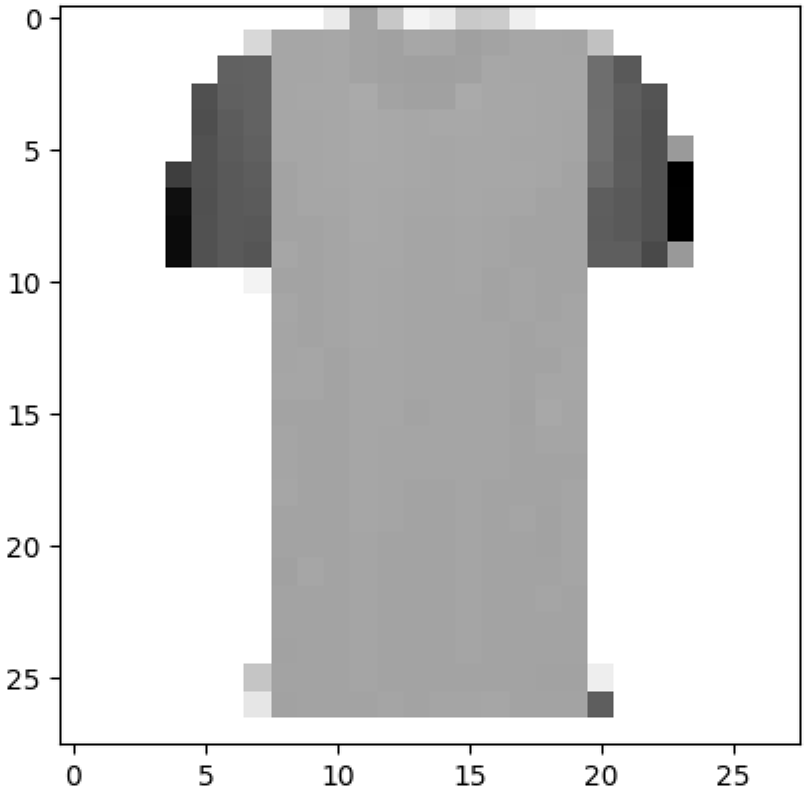
```
import numpy
X = []
Y = []
y = []
x_test = []

for features,label in test_data:
    X.append(features)
    Y.append(label)

for i in range(len(X)):
    for j in range(len(X[i])):
        for k in range(len(X[i][j])):
            t = X[i][j][k]
            t = 255-t
            if t <= 15:
                t = 0
            X[i][j][k] = t

print("x = ", X[0])
plt.imshow(X[0], cmap=plt.cm.binary)
plt.show()

X = tf.keras.utils.normalize(X, axis=1)

print("na norm", X[0])
plt.imshow(X[0], cmap=plt.cm.binary)
plt.show()
```

```
x =  [[  0   0   0   0   0   0   0   0   0   0  55 247 149  31  54 141 133  43
    0   0   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0  58 230 233 229 246 249 229 232 249 239 230
  227 229  97   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0 229 231 229 231 229 244 248 249 247 246 228 228
  227 227 227 236   0   0   0   0   0   0]
 [  0   0   0   0   0 237 231 231 229 229 230 228 244 246 244 222 228 227
  227 227 228 230 226   0   0   0   0   0]
 [  0   0   0   0   0 240 237 231 229 231 231 231 230 231 226 228 228 227
  227 228 225 232 229   0   0   0   0   0]
 [  0   0   0   0   0 236 239 235 231 231 231 231 231 229 231 229 228 228
  228 228 226 234 230  91   0   0   0   0]
 [  0   0   0   0 188 235 242 239 234 231 231 232 231 231 231 231 229 227
  228 232 232 233 230 230   0   0   0   0]
 [  0   0   0   0 234 237 241 243 236 233 233 232 232 233 233 231 231 229
  231 231 253 235 230 228   0   0   0   0]
 [  0   0   0   0 238 236 241 247 235 236 235 234 234 234 234 233 233 233
  232 231 254 236 230 228   0   0   0   0]
 [  0   0   0   0 238 235 241 251 229 237 236 235 234 234 234 233 234 233
  232 230 252 230 241  92   0   0   0   0]
 [  0   0   0   0   0   0   0  18 234 237 235 236 235 235 235 233 236 232
  235 231   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 231 239 235 236 235 235 235 234 236 231
  231 228   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 232 237 236 237 235 235 235 234 235 234
  230 229   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 233 232 237 238 235 235 235 234 235 235
  231 225   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 229 231 239 238 236 236 236 234 235 236
  226 227   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 236 237 238 238 236 238 236 235 234 238
  222 229   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 232 240 238 238 237 236 236 235 234 237
  229 229   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 232 239 239 238 237 236 236 236 234 236
  232 230   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 230 240 238 238 238 237 237 236 236 233
  235 229   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 235 240 237 238 238 237 237 236 236 232
  237 229   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 238 238 239 240 240 237 237 235 236 234
  236 228   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 244 233 238 240 240 238 237 236 236 234
  231 229   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 236 239 240 240 241 238 237 236 236 235
```

```
  230 233   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 235 238 238 240 241 238 237 236 236 233
  233 233   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0 241 238 240 241 241 238 237 236 236 235
  234 230   0   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0  86 238 240 240 241 241 239 237 237 236 236
  236 236  27   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0  38 240 239 240 243 239 238 236 234 231 234
  232 230 252   0   0   0   0   0   0   0]
 [  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
    0   0   0   0   0   0   0   0   0   0]]
```



```
na norm [[0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.04568184 0.19987875
  0.12203431 0.02572315 0.04488147 0.11704603 0.1109159  0.03623168
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.08478083 0.19292559 0.19382206 0.19020255 0.19906953
  0.20393654 0.19001938 0.19282409 0.2066983  0.19931503 0.19379737
  0.19292227 0.19564676 0.13390984 0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.34065502 0.33766157 0.19208679 0.19215836 0.19020255 0.19745107
  0.20311752 0.20661496 0.20529117 0.20420796 0.19014154 0.19211217
  0.19292227 0.19393806 0.31337663 0.35770471 0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.37864063
  0.34363017 0.33766157 0.19208679 0.19049465 0.19103313 0.18450346
  0.19984143 0.20412562 0.20279775 0.18428523 0.19014154 0.19126957
  0.19292227 0.19393806 0.31475714 0.34861052 0.36994638 0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.38343355
  0.35255563 0.33766157 0.19208679 0.19215836 0.19186371 0.18693114
  0.18837512 0.19167894 0.18783726 0.18926592 0.19014154 0.19126957
  0.19292227 0.19479241 0.3106156  0.35164191 0.37485718 0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.37704299
  0.35553078 0.34350852 0.1937644  0.19215836 0.19186371 0.18693114
  0.18919414 0.19001938 0.19199295 0.19009603 0.19014154 0.19211217
  0.19377215 0.19479241 0.31199611 0.35467331 0.37649411 0.21839881
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.41686476 0.37544535
  0.35999351 0.34935547 0.19628082 0.19215836 0.19186371 0.18774037
  0.18919414 0.19167894 0.19199295 0.19175626 0.19097549 0.19126957
  0.19377215 0.19820982 0.32027919 0.35315761 0.37649411 0.551997
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.51886359 0.37864063
  0.35850594 0.35520243 0.19795844 0.19382206 0.19352487 0.18774037
  0.19001316 0.19333849 0.19365523 0.19175626 0.1926434  0.19295477
  0.19632178 0.19735547 0.34926998 0.35618901 0.37649411 0.54719702
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.52773305 0.37704299
  0.35850594 0.36104938 0.19711963 0.19631763 0.19518602 0.18935882
  0.19165121 0.19416827 0.19448637 0.19341648 0.19431131 0.19632516
  0.19717166 0.19735547 0.3506505  0.35770471 0.37649411 0.54719702
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.52773305 0.37544535
  0.35850594 0.36689633 0.19208679 0.19714948 0.1960166  0.19016804
  0.19165121 0.19416827 0.19448637 0.19341648 0.19514526 0.19632516
  0.19717166 0.19650111 0.34788947 0.34861052 0.39450035 0.2207988
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.02631129 0.19628082 0.19714948 0.19518602 0.19097727
  0.19247023 0.19499805 0.19531751 0.19341648 0.19681317 0.19548256
  0.19972129 0.19735547 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.1937644  0.19881319 0.19518602 0.19097727
  0.19247023 0.19499805 0.19531751 0.1942466  0.19681317 0.19463996
  0.19632178 0.19479241 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19460321 0.19714948 0.1960166  0.19178649
  0.19247023 0.19499805 0.19531751 0.1942466  0.19597922 0.19716775
  0.1954719  0.19564676 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19544202 0.19299021 0.19684718 0.19259572
  0.19247023 0.19499805 0.19531751 0.1942466  0.19597922 0.19801035
  0.19632178 0.19222935 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19208679 0.19215836 0.19850834 0.19259572
  0.19328925 0.19582783 0.19614865 0.1942466  0.19597922 0.19885295
  0.19207239 0.19393806 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19795844 0.19714948 0.19767776 0.19259572
  0.19328925 0.19748739 0.19614865 0.19507671 0.19514526 0.20053814
  0.18867288 0.19564676 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19460321 0.19964504 0.19767776 0.19259572
  0.19410827 0.19582783 0.19614865 0.19507671 0.19514526 0.19969555
  0.19462202 0.19564676 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19460321 0.19881319 0.19850834 0.19259572
  0.19410827 0.19582783 0.19614865 0.19590682 0.19514526 0.19885295
  0.19717166 0.19650111 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19292559 0.19964504 0.19767776 0.19259572
  0.19492729 0.19665761 0.19697978 0.19590682 0.19681317 0.19632516
  0.19972129 0.19564676 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19711963 0.19964504 0.19684718 0.19259572
  0.19492729 0.19665761 0.19697978 0.19590682 0.19681317 0.19548256
  0.20142105 0.19564676 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19963605 0.19798134 0.19850834 0.19421417
  0.19656534 0.19665761 0.19697978 0.19507671 0.19681317 0.19716775
  0.20057117 0.19479241 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.20466889 0.19382206 0.19767776 0.19421417
  0.19656534 0.19748739 0.19697978 0.19590682 0.19681317 0.19716775
  0.19632178 0.19564676 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19795844 0.19881319 0.19933892 0.19421417
  0.19738436 0.19748739 0.19697978 0.19590682 0.19681317 0.19801035
  0.1954719  0.19906417 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.19711963 0.19798134 0.19767776 0.19421417
  0.19738436 0.19748739 0.19697978 0.19590682 0.19681317 0.19632516
  0.19802153 0.19906417 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.20215247 0.19798134 0.19933892 0.1950234
  0.19738436 0.19748739 0.19697978 0.19590682 0.19681317 0.19801035
  0.19887141 0.19650111 0.         0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.1257095  0.19963605 0.19964504 0.19933892 0.1950234
  0.19738436 0.19831717 0.19697978 0.19673694 0.19681317 0.19885295
  0.20057117 0.20162723 0.03727387 0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.05554606 0.20131366 0.19881319 0.19933892 0.19664185
  0.19574632 0.19748739 0.19614865 0.1942466  0.1926434  0.19716775
  0.19717166 0.19650111 0.34788947 0.         0.         0.
  0.         0.         0.         0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.         0.         0.
  0.         0.         0.         0.        ]]
```

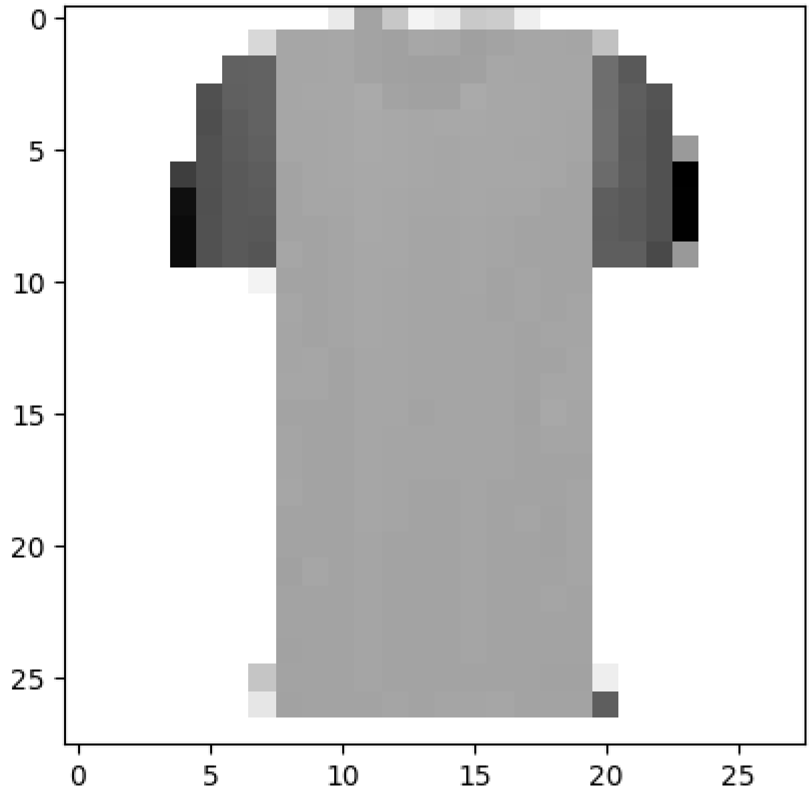


Here we split the data into two lists; the pictures and the catagories. Afterward we invert all the colors of the images and remove the very light gray(almost white). This is to add contrast. After that the images are normalized this means all the values are made between zero and one and the before and after is shown.

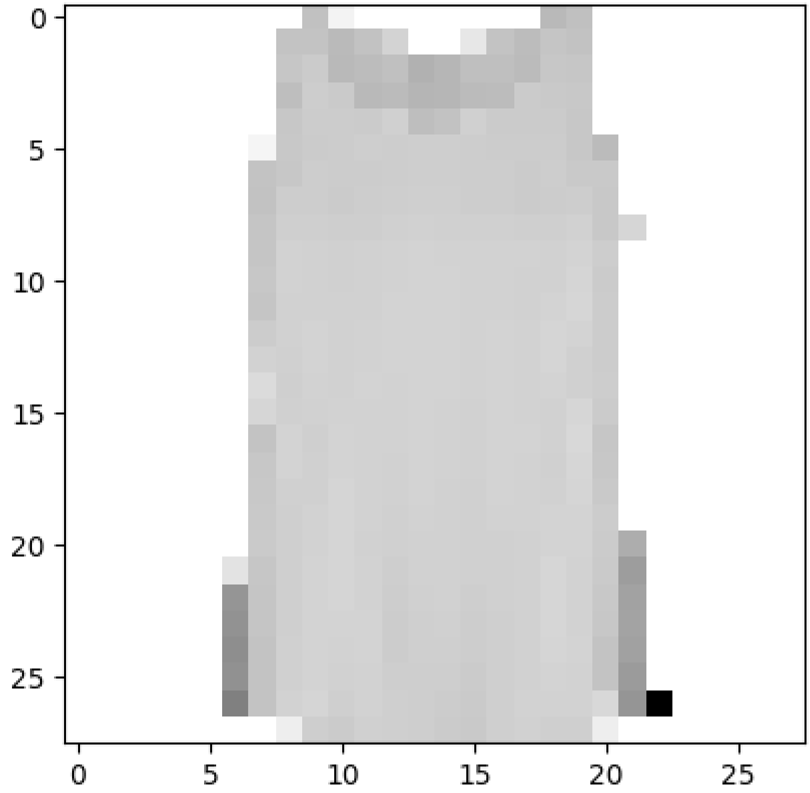
In [12]:

```python
g=0
f=0

for x, y in zip(X, Y):
    print(y)
    x = np.expand_dims(x, axis=0)
    predictions = new_model.predict([x])
    x = np.expand_dims(x, axis=-1)
    x = x[0,:,:,0]
    print(predictions)
    plt.imshow(x, cmap=plt.cm.binary)
    plt.show()
    print("predict =", CATEGORIES[np.argmax(predictions)])
    if (y==np.argmax(predictions)):
        g = g+1
        print("correct")
    else:
        f = f+1
        print("wrong")

acc = g/(g+f)
tot = g + f
print("total =", tot)
print("acc =", acc*100,"%")
```

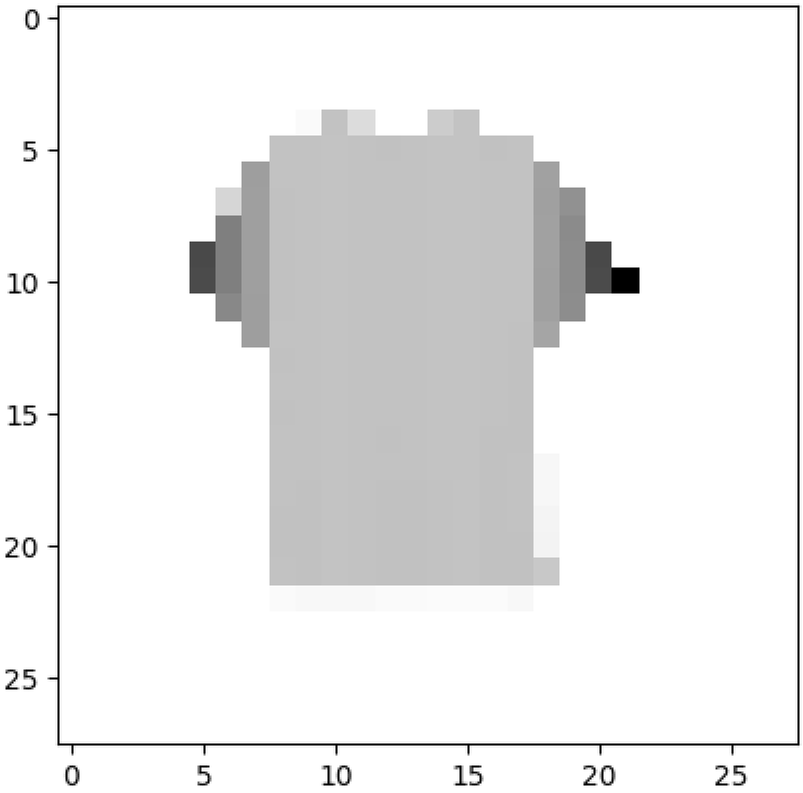
```
0
1/1 [==============================] - 0s 116ms/step
[[9.8633516e-01 9.3488746e-09 2.5658829e-03 3.0601735e-03 1.4609611e-04
  2.8130142e-11 7.8925360e-03 3.3202521e-09 1.5230577e-07 4.6405957e-10]]
```



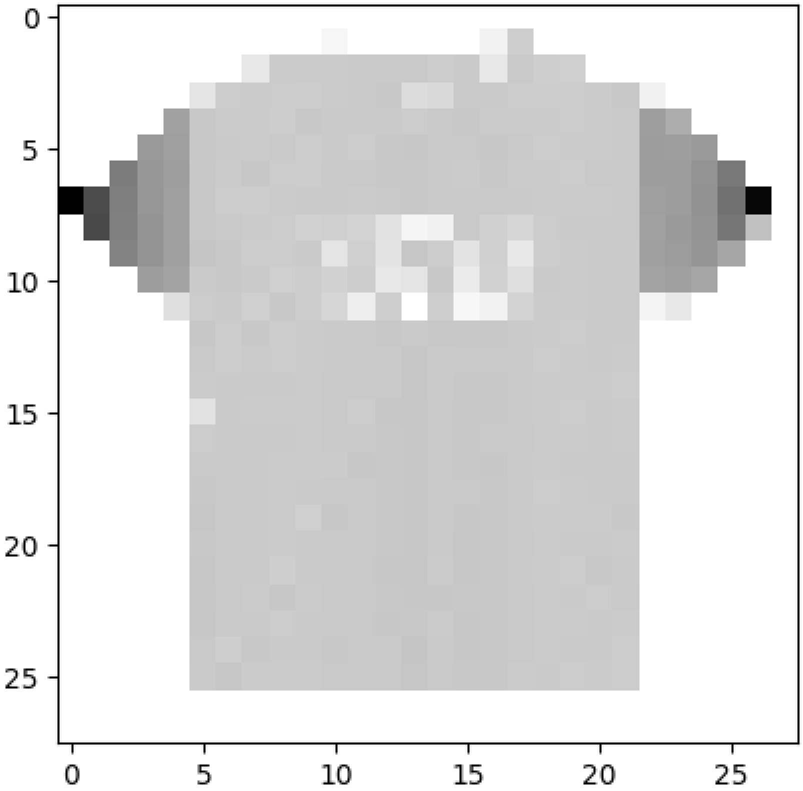
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 19ms/step
[[9.5893610e-01 2.0195850e-05 2.3310822e-04 1.3851582e-04 1.9722397e-06
  7.0724222e-09 4.0660173e-02 7.9229476e-06 5.2974343e-07 1.3769738e-06]]
```



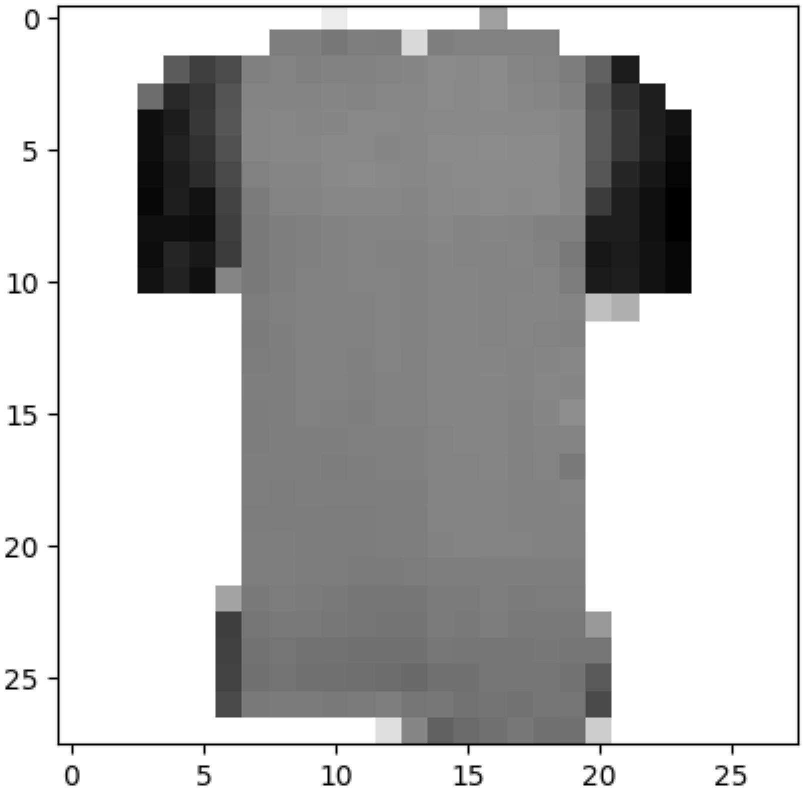
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 19ms/step
[[9.8423135e-01 1.2561351e-09 4.2674989e-03 1.6037398e-04 3.8428283e-05
  3.2733418e-08 4.0963772e-03 7.1372483e-03 2.4314269e-05 4.4295899e-05]]
```



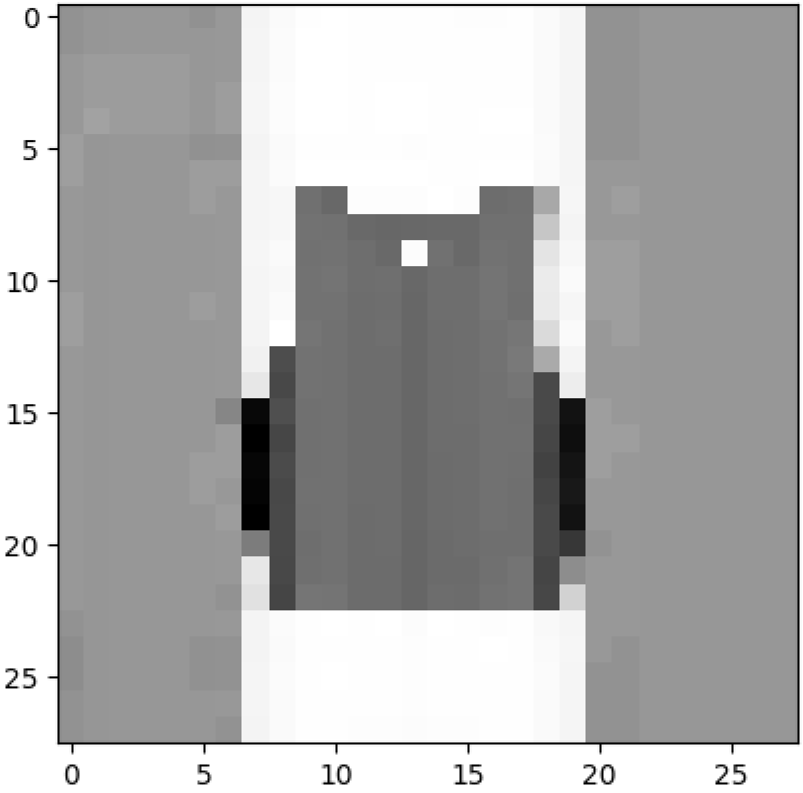
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 21ms/step
[[9.9624795e-01 4.3182538e-07 1.5461742e-03 4.8039090e-07 4.0262737e-08
  1.3694382e-10 2.1077145e-03 1.0518821e-08 9.7197517e-05 5.4162541e-10]]
```



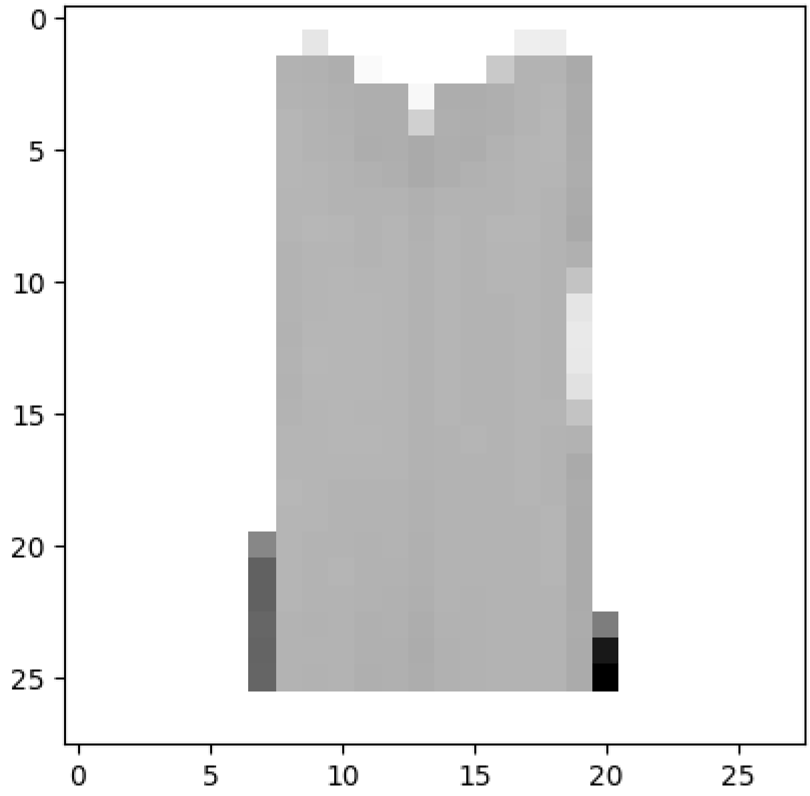
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 20ms/step
[[9.3116266e-01 1.7852156e-10 2.5650648e-05 4.1743724e-09 5.1497118e-08
  7.2409323e-15 6.8811670e-02 1.9862352e-12 4.0333806e-13 3.7993070e-14]]
```



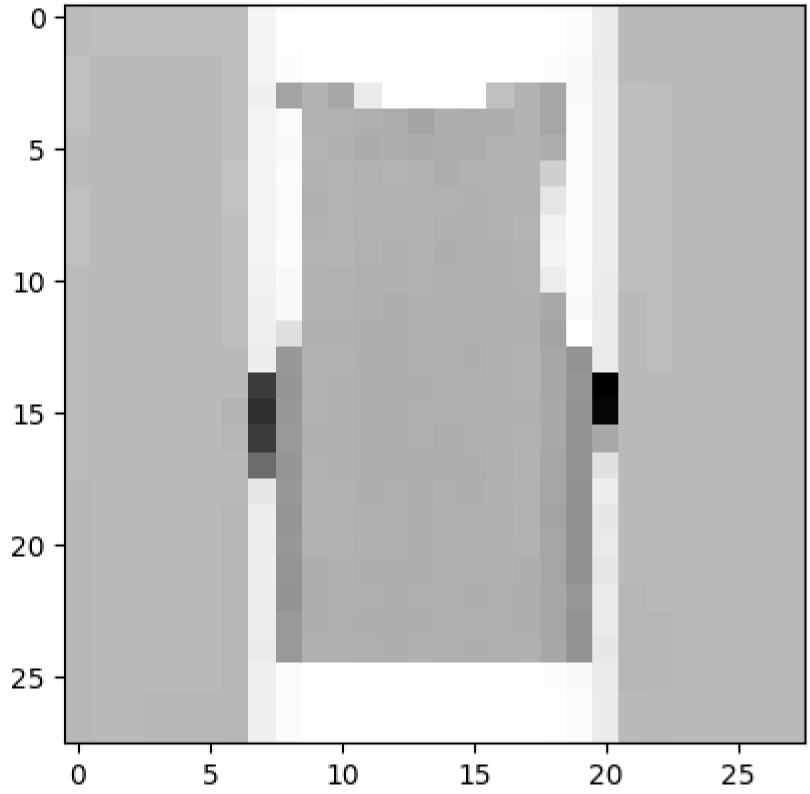
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 22ms/step
[[7.3927166e-03 1.3951501e-01 1.2579086e-02 1.6665938e-07 7.3887515e-01
  1.7451670e-02 6.4153105e-02 5.1425456e-04 9.2894314e-03 1.0229363e-02]]
```



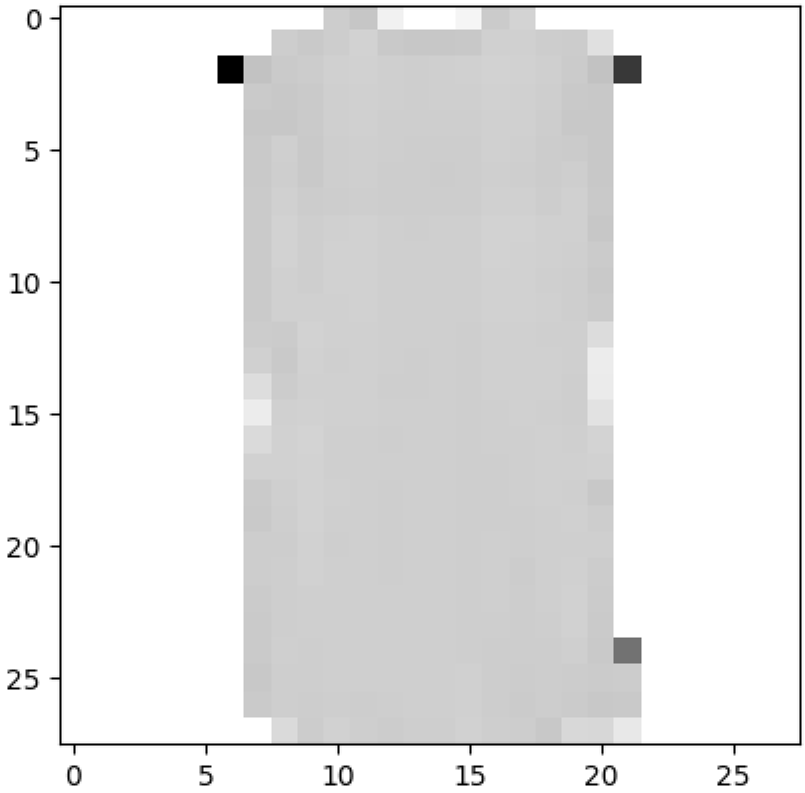
```
predict = 4. coat
wrong
0
1/1 [==============================] - 0s 21ms/step
[[9.7666991e-01 1.7318029e-05 4.3480027e-06 7.2096242e-04 2.3308573e-07
  6.5302789e-05 2.2514420e-02 1.8508729e-06 1.5336749e-07 5.4241864e-06]]
```



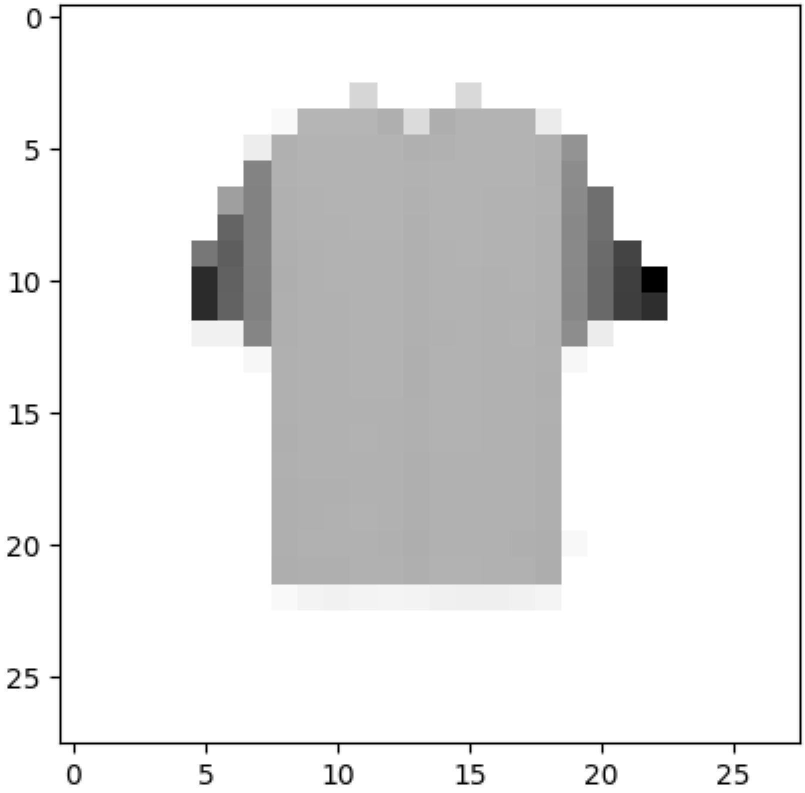
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 21ms/step
[[1.0840127e-03 9.7663316e-04 2.0667821e-01 8.3472081e-02 1.9454323e-01
  2.9309571e-05 1.1522582e-01 8.8846660e-04 3.8666174e-01 1.0440544e-02]]
```



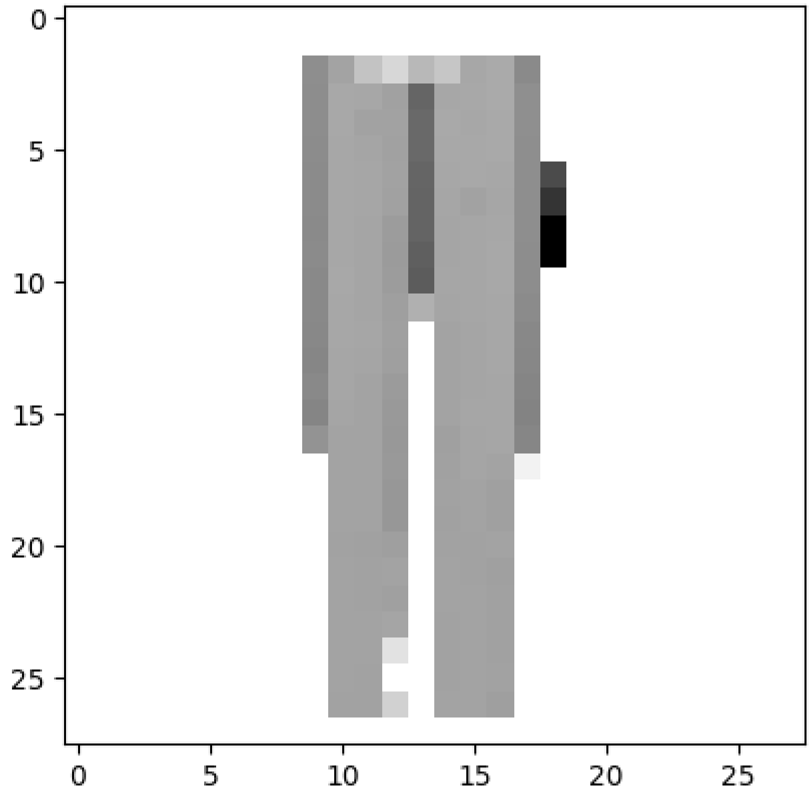
```
predict = 8. bag
wrong
0
1/1 [==============================] - 0s 23ms/step
[[4.3787831e-01 1.4363234e-03 1.2987697e-01 1.7593199e-02 2.8540060e-04
  1.6083173e-07 4.1283989e-01 1.0874666e-06 2.2631648e-05 6.6118904e-05]]
```



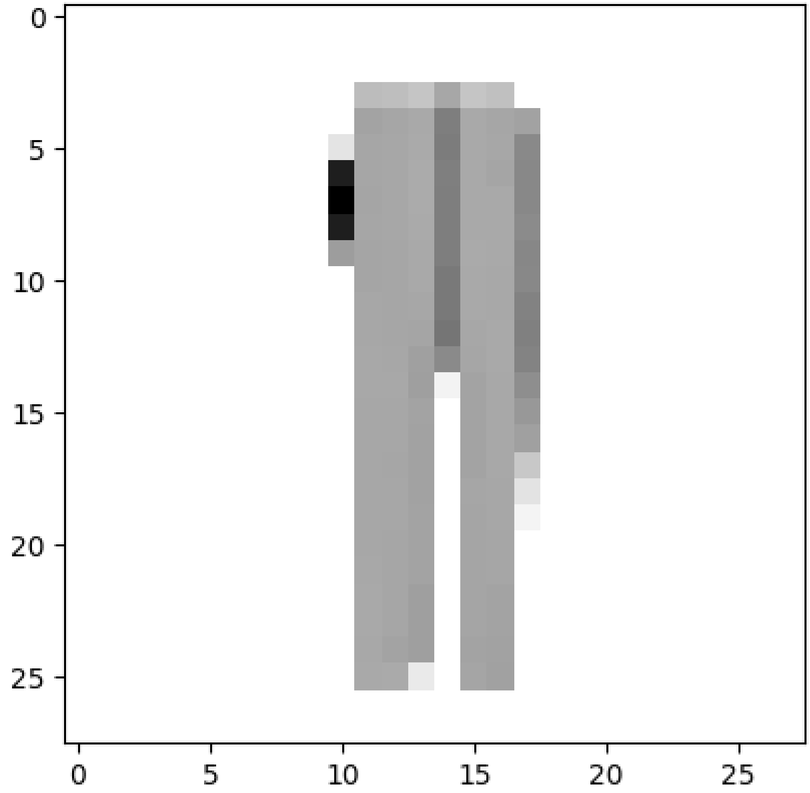
```
predict = 0. T-shirt_top
correct
0
1/1 [==============================] - 0s 20ms/step
[[2.6705047e-01 7.4653151e-08 1.2280847e-02 8.8411225e-03 4.3466012e-03
  7.1952083e-05 9.4921932e-02 6.0710859e-01 1.7814760e-03 3.5969254e-03]]
```



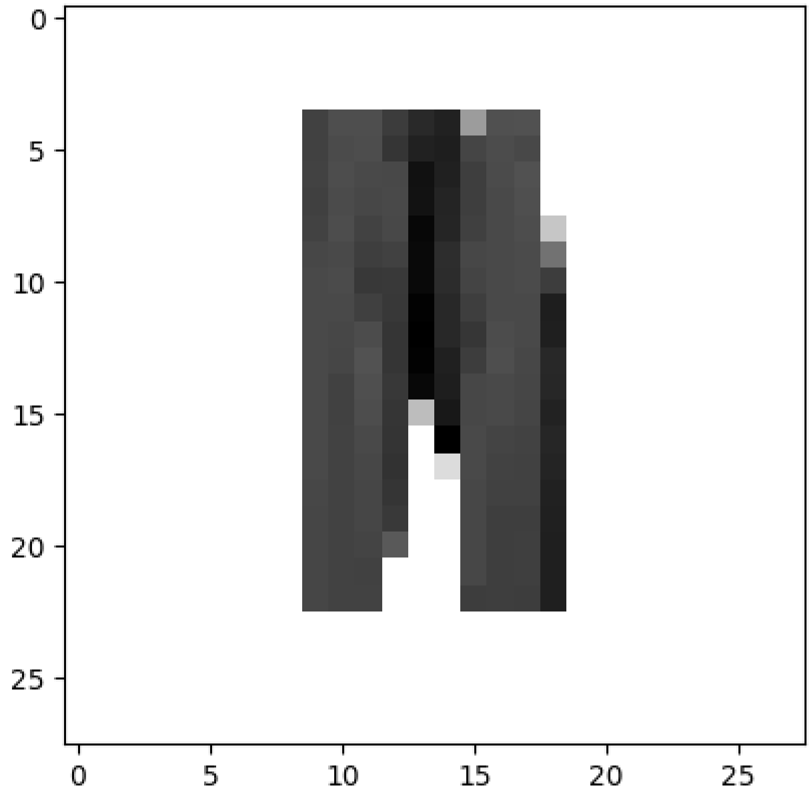
```
predict = 7. sneaker
wrong
1
1/1 [==============================] - 0s 56ms/step
[[1.11848905e-07 9.99999881e-01 2.01099337e-12 1.01732700e-09
  2.09965400e-13 2.14556173e-14 2.55605781e-09 1.42751813e-16
  2.25824418e-13 3.45473399e-16]]
```



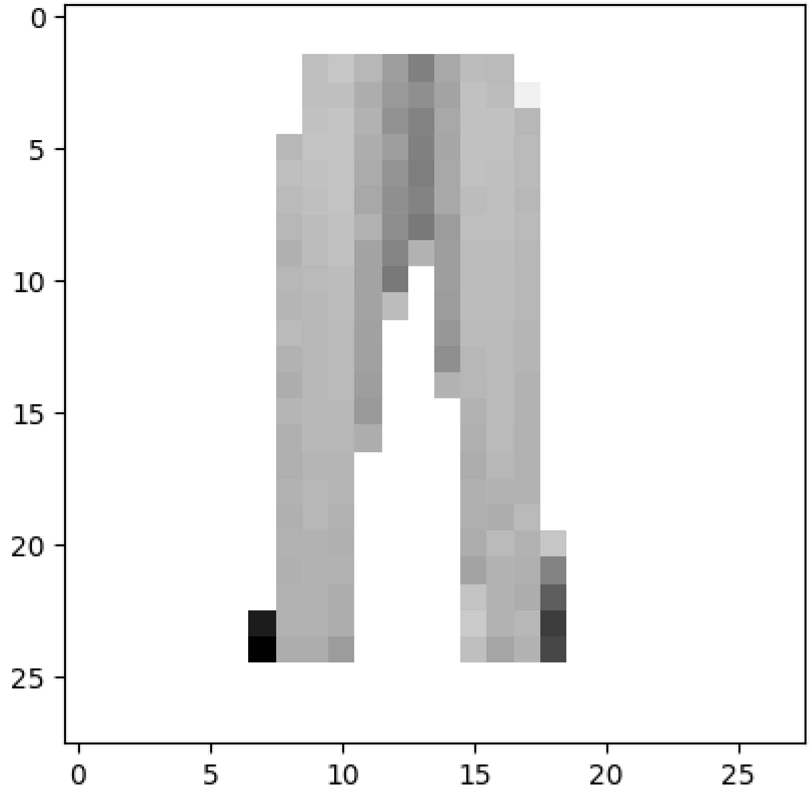
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 21ms/step
[[2.8127599e-06 9.8215860e-01 5.9274938e-05 1.7486025e-02 1.6968354e-09
  2.4393503e-05 1.6624105e-07 2.3955997e-07 9.2410461e-05 1.7604169e-04]]
```



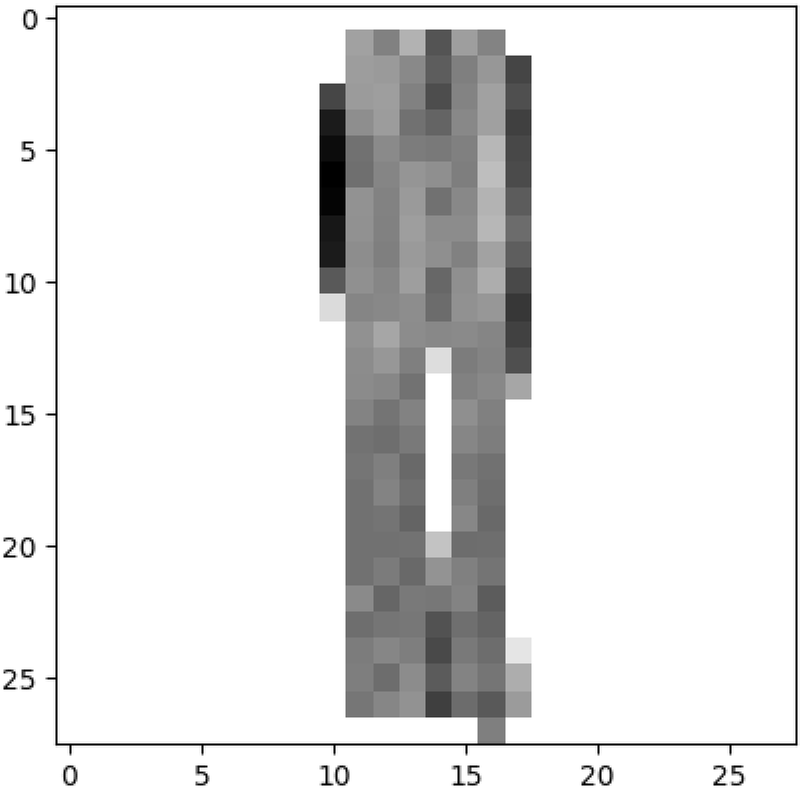
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 20ms/step
[[2.4760452e-10 9.9999988e-01 2.6363872e-12 9.8935502e-08 7.0000590e-12
  4.1413665e-12 9.5599528e-09 8.2544420e-16 8.6499791e-14 5.6072239e-12]]
```



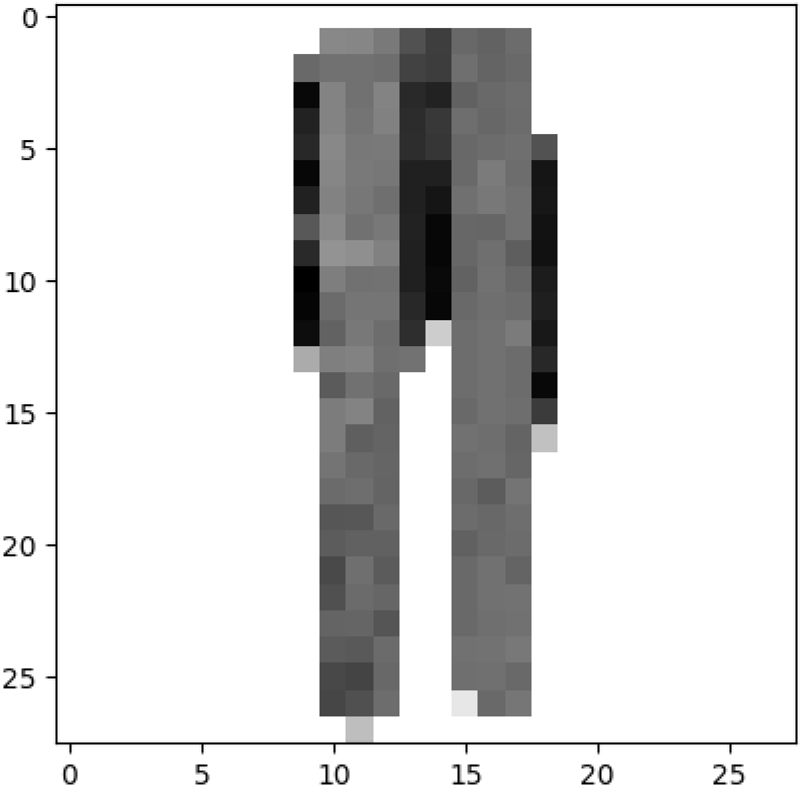
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 21ms/step
[[6.6008162e-08 9.9999988e-01 4.3056166e-12 4.9979363e-09 1.1750830e-15
  4.2307322e-15 4.3596224e-11 1.5250947e-18 5.1937380e-14 7.0726796e-19]]
```



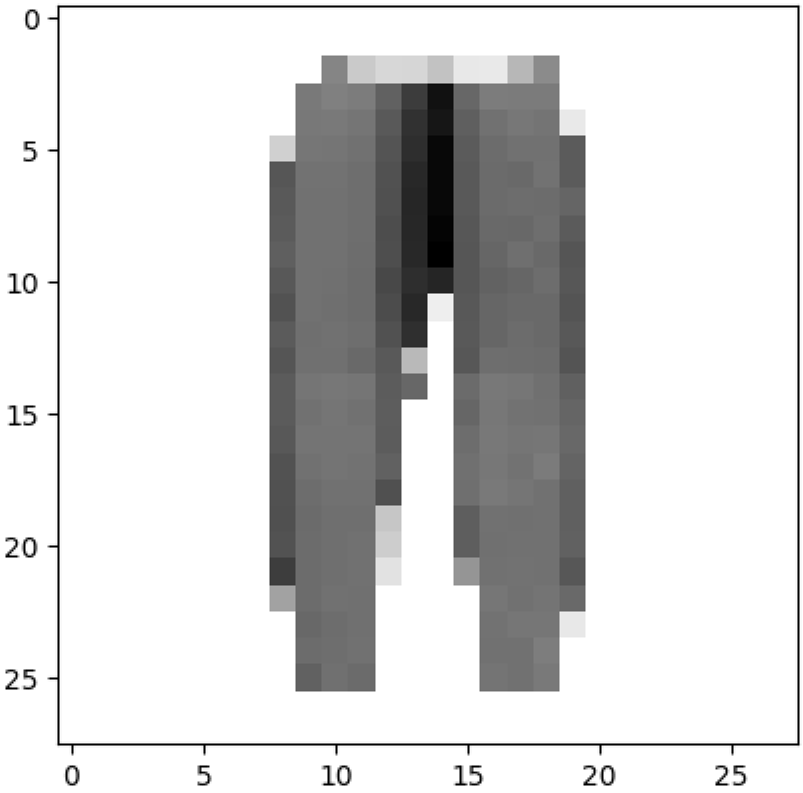
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 21ms/step
[[8.3184306e-05 9.8056030e-01 8.3694613e-05 1.9200332e-02 3.7310848e-08
  1.5289547e-08 7.0718961e-05 4.4185926e-09 1.6675802e-06 5.6359784e-08]]
```



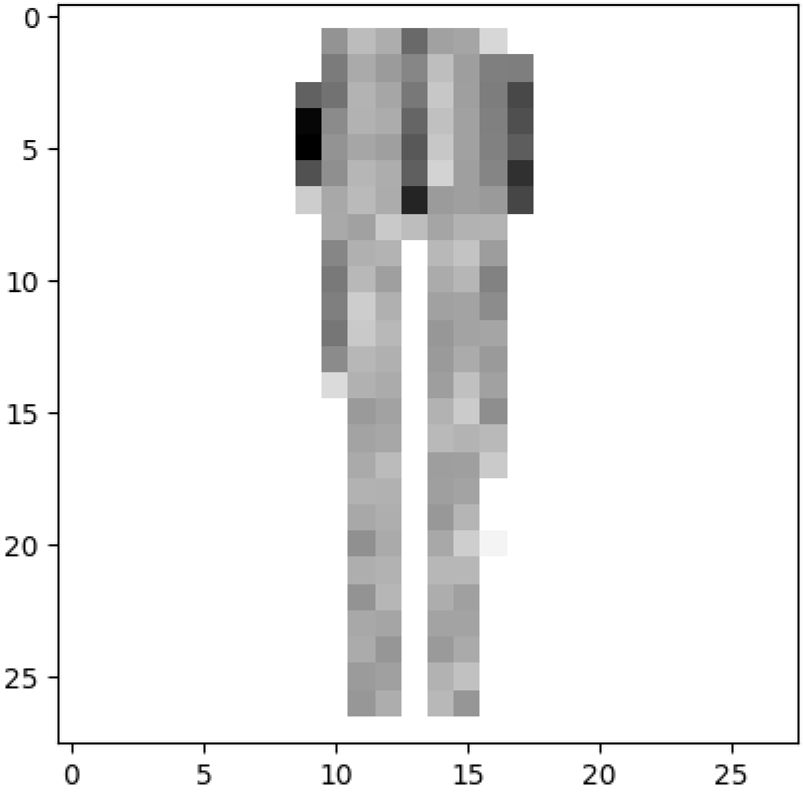
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 20ms/step
[[1.3041534e-12 1.0000000e+00 4.1811284e-13 4.3831352e-11 1.2054404e-13
  2.5237985e-13 8.0060492e-13 1.5379309e-17 2.1944315e-15 2.5436922e-15]]
```



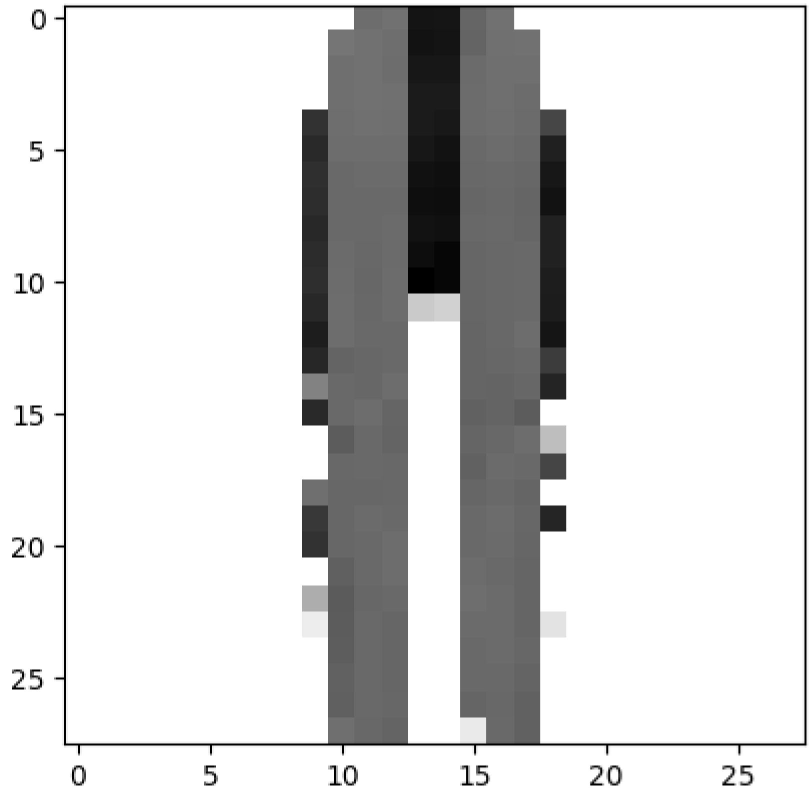
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 23ms/step
[[4.4849671e-10 1.0000000e+00 4.7819228e-14 2.8628100e-11 3.7282699e-12
  7.7187670e-09 3.3857969e-11 1.1792868e-14 1.9512145e-10 1.7007541e-13]]
```



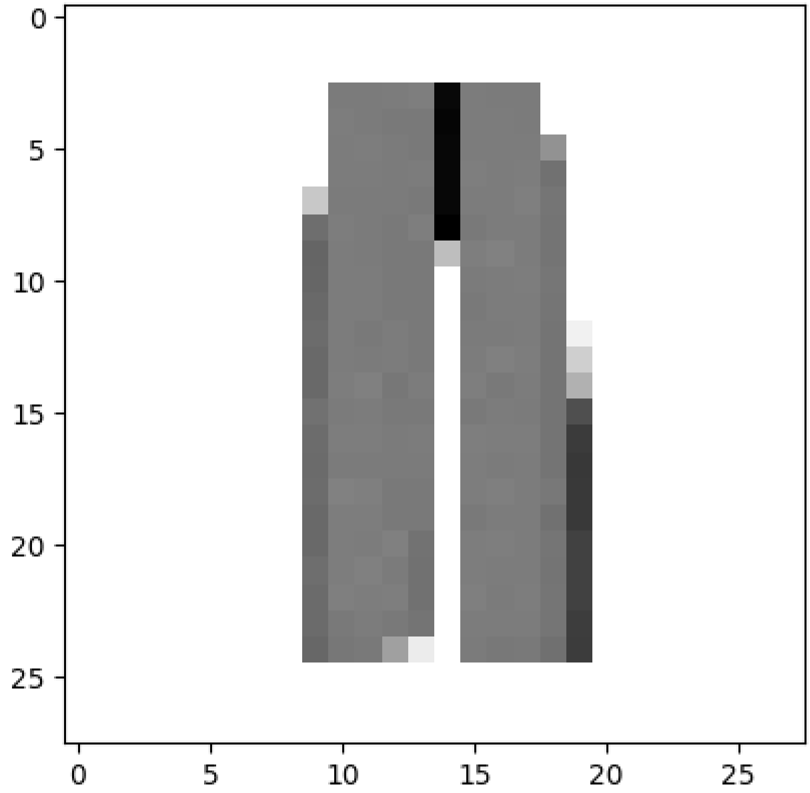
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 21ms/step
[[3.5129799e-10 1.0000000e+00 3.6718896e-12 2.6261004e-11 5.1834017e-16
  4.9022323e-16 1.7953636e-10 1.3095441e-17 3.4661247e-17 3.1800171e-16]]
```



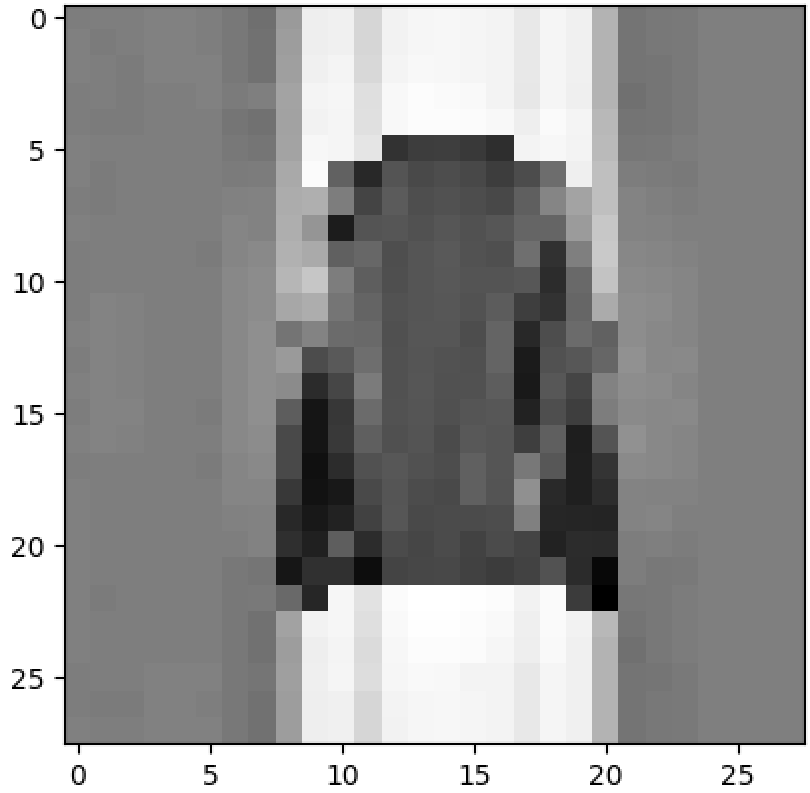
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 21ms/step
[[1.4381396e-14 1.0000000e+00 4.0298694e-15 1.5957675e-13 5.4825825e-15
  2.9391859e-15 1.9584427e-15 1.4584005e-19 2.9687994e-15 8.0148598e-18]]
```



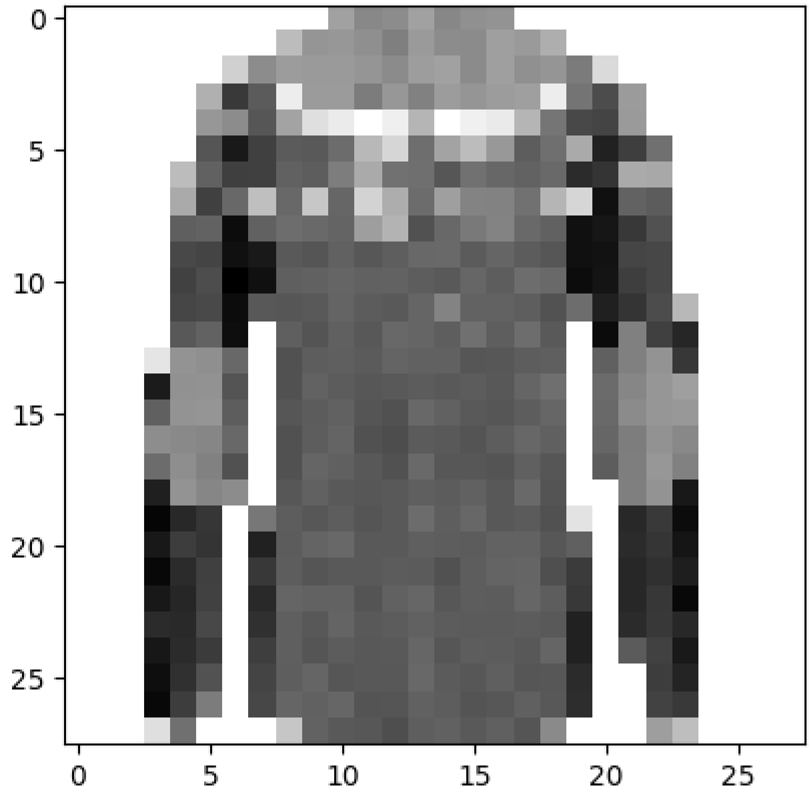
```
predict = 1. trouser
correct
1
1/1 [==============================] - 0s 20ms/step
[[2.7688479e-08 9.9999714e-01 1.5848781e-11 1.4993012e-07 1.0871392e-09
  1.2661451e-06 2.0873818e-09 7.4736300e-10 3.0449023e-08 1.4049918e-06]]
```



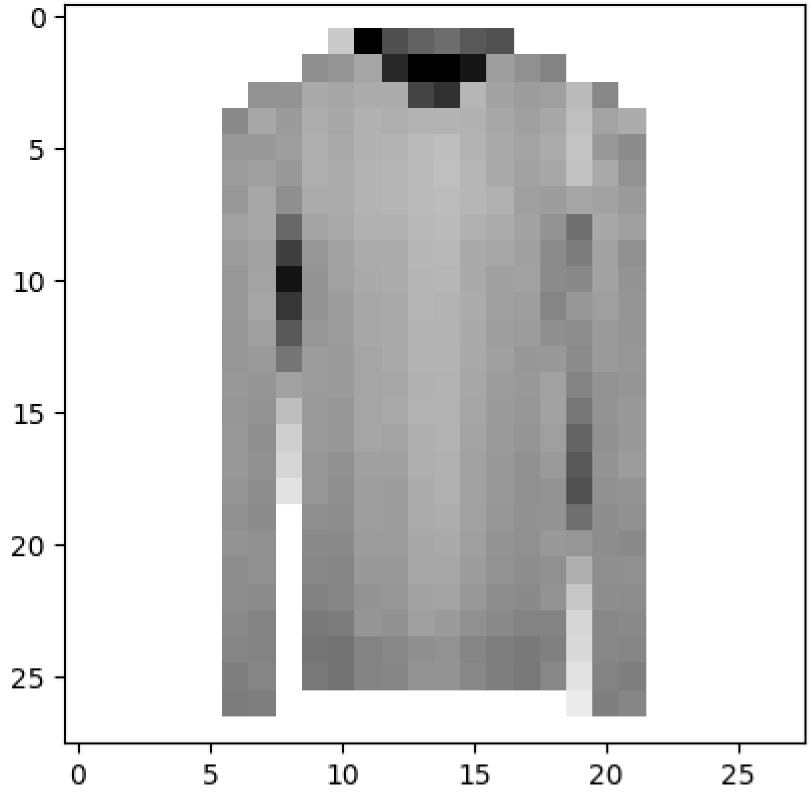
```
predict = 1. trouser
correct
2
1/1 [==============================] - 0s 20ms/step
[[4.4257995e-03 1.3507062e-02 1.3364686e-01 1.1510426e-03 4.4146893e-03
  6.0068746e-04 2.2526117e-01 3.7460353e-03 6.0902411e-01 4.2225551e-03]]
```



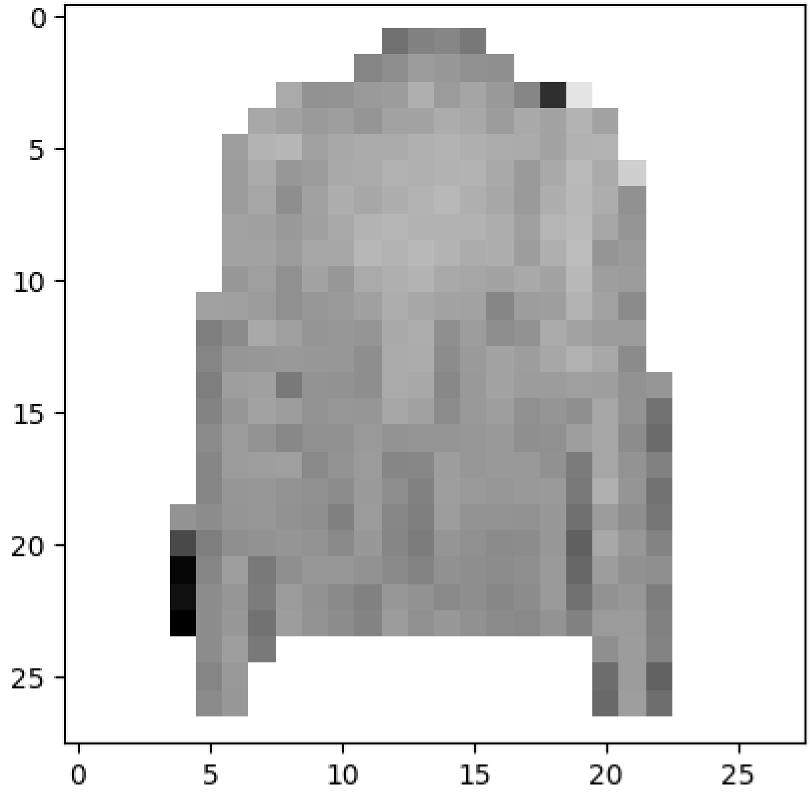
```
predict = 8. bag
wrong
2
1/1 [==============================] - 0s 21ms/step
[[6.5692875e-05 3.3844555e-10 9.4901365e-01 9.6224845e-08 2.8319700e-02
  2.3666262e-11 2.2600837e-02 2.6325506e-10 8.7268273e-09 3.1053954e-10]]
```



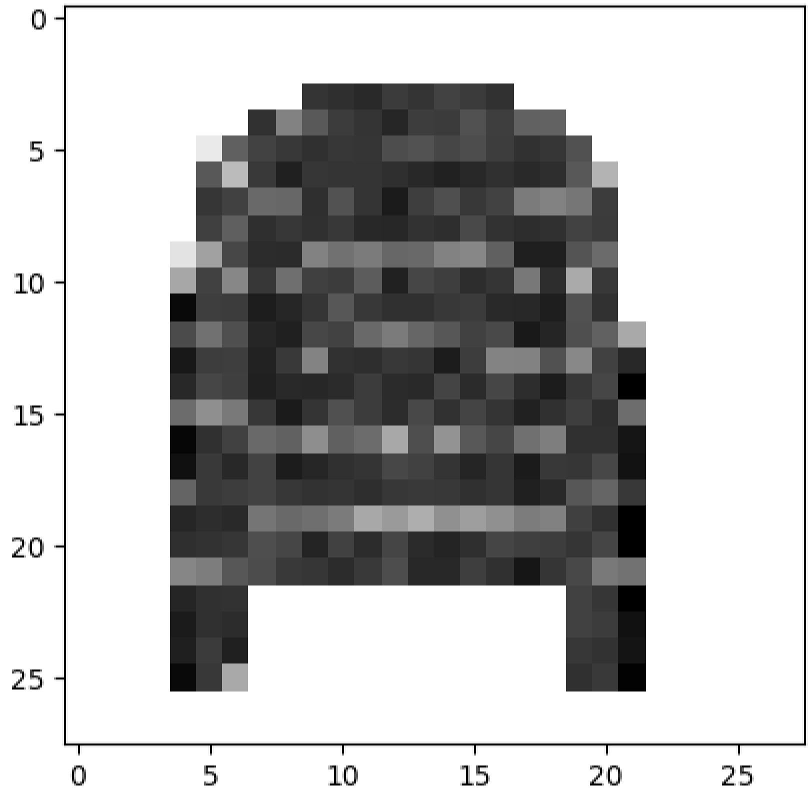
```
predict = 2. pullover
correct
2
1/1 [==============================] - 0s 22ms/step
[[2.9622790e-01 2.1882700e-08 7.8678206e-02 9.3675493e-07 2.7478212e-03
  3.0254937e-12 6.2234515e-01 8.3413366e-11 5.6684341e-11 2.3776347e-11]]
```



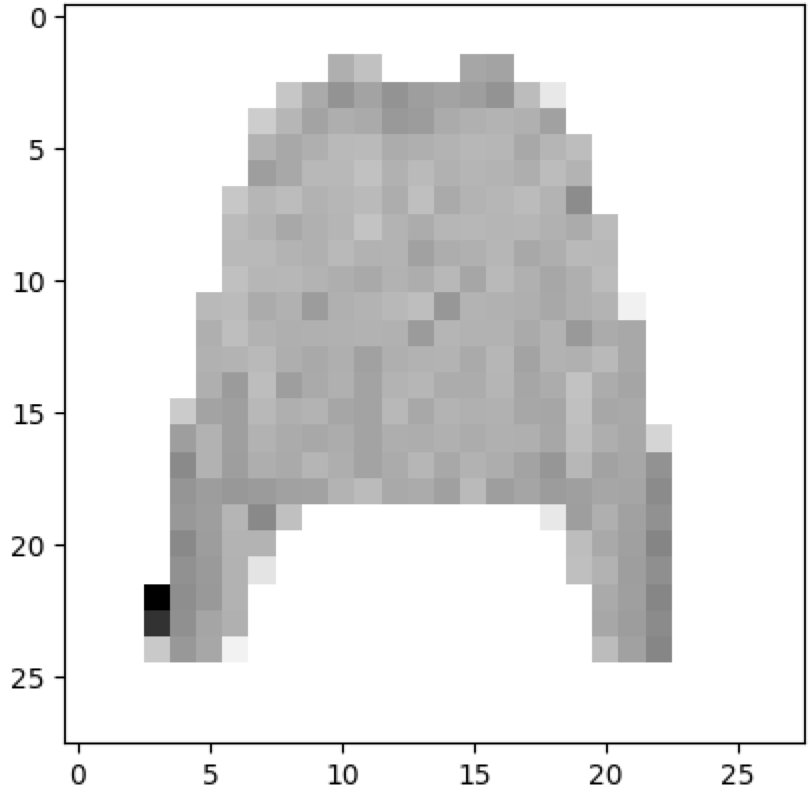
```
predict = 6. shirt
wrong
2
1/1 [==============================] - 0s 22ms/step
[[4.04117491e-05 3.33750506e-07 3.58644378e-04 1.01318825e-07
  9.00278687e-01 4.04205522e-08 9.87949744e-02 2.90462850e-07
  5.26392891e-04 1.61158951e-07]]
```



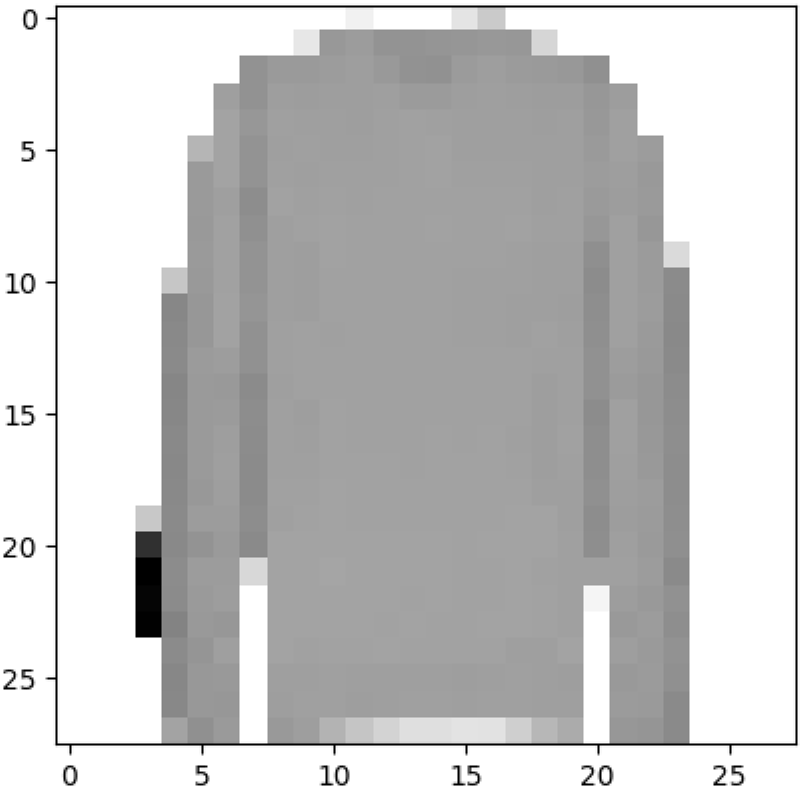
```
predict = 4. coat
wrong
2
1/1 [==============================] - 0s 22ms/step
[[3.3125165e-04 4.4581710e-04 2.5171189e-02 1.1506357e-05 9.6304816e-01
  1.9340883e-05 6.6917199e-03 2.3372739e-05 4.2130030e-03 4.4600823e-05]]
```



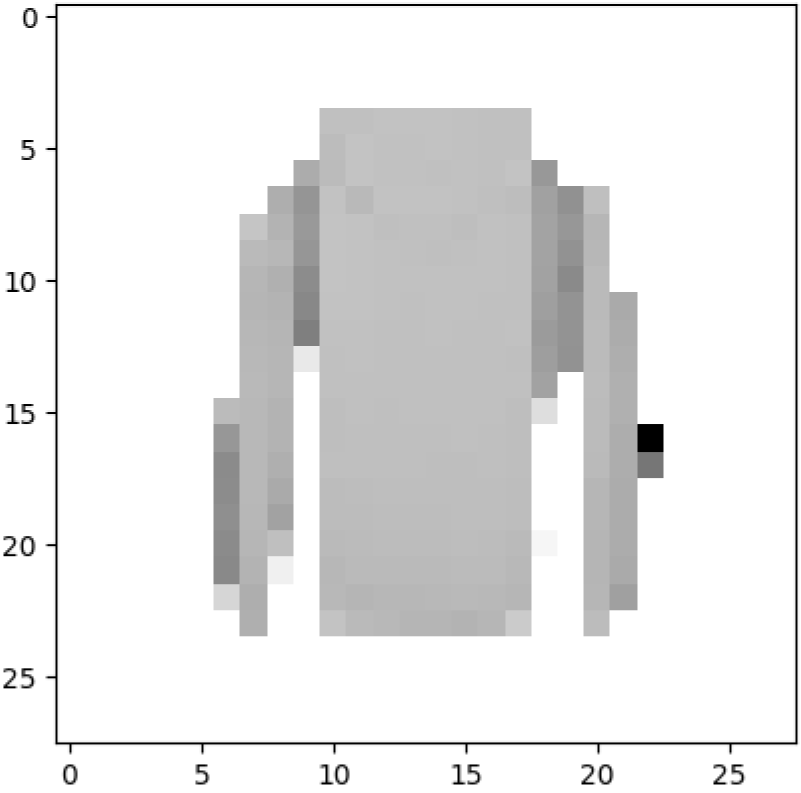
```
predict = 4. coat
wrong
2
1/1 [==============================] - 0s 21ms/step
[[6.0141290e-05 1.0345045e-05 5.0523475e-02 1.3616239e-03 9.3241990e-01
  4.8249873e-05 1.5380154e-02 1.0184626e-04 8.6380998e-05 7.8581852e-06]]
```



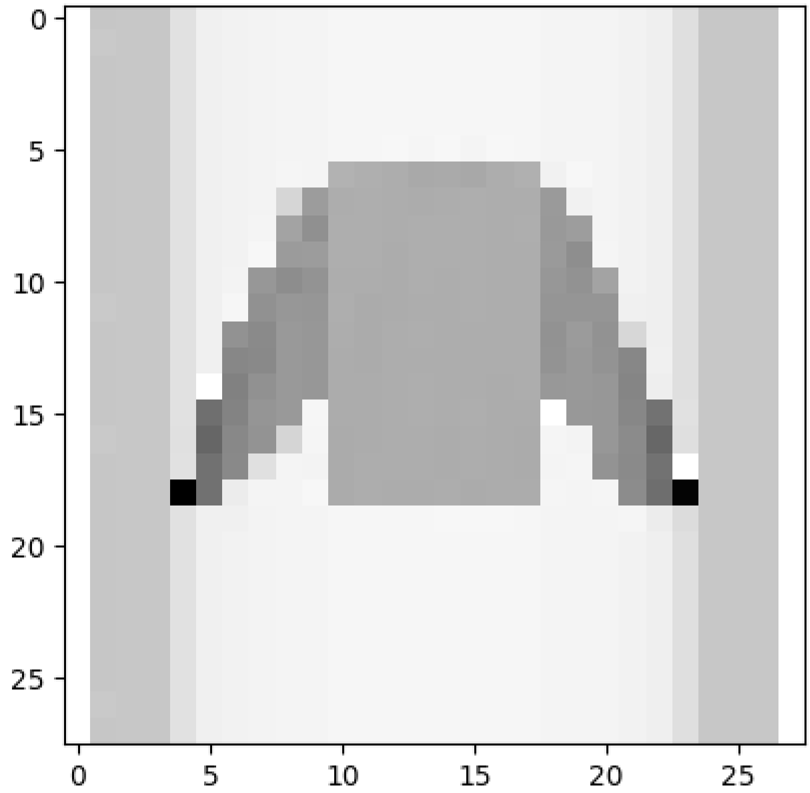
```
predict = 4. coat
wrong
2
1/1 [==============================] - 0s 22ms/step
[[7.0817037e-03 7.8650288e-07 4.9116588e-01 2.0093196e-04 2.9753281e-02
  1.4744167e-07 4.7146684e-01 1.7779763e-06 3.2763209e-04 9.3887854e-07]]
```



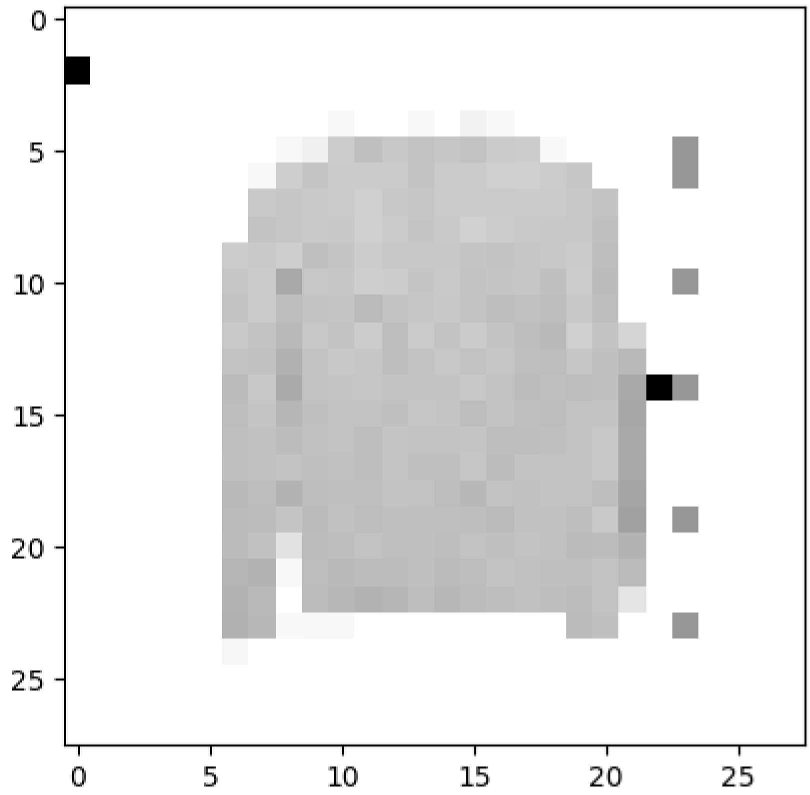
```
predict = 2. pullover
correct
2
1/1 [==============================] - 0s 21ms/step
[[3.0463277e-06 4.7767510e-09 8.7132053e-03 9.7530717e-01 1.5488023e-02
  1.3221185e-06 4.8685036e-04 1.7872136e-07 1.9733888e-07 4.5191246e-08]]
```



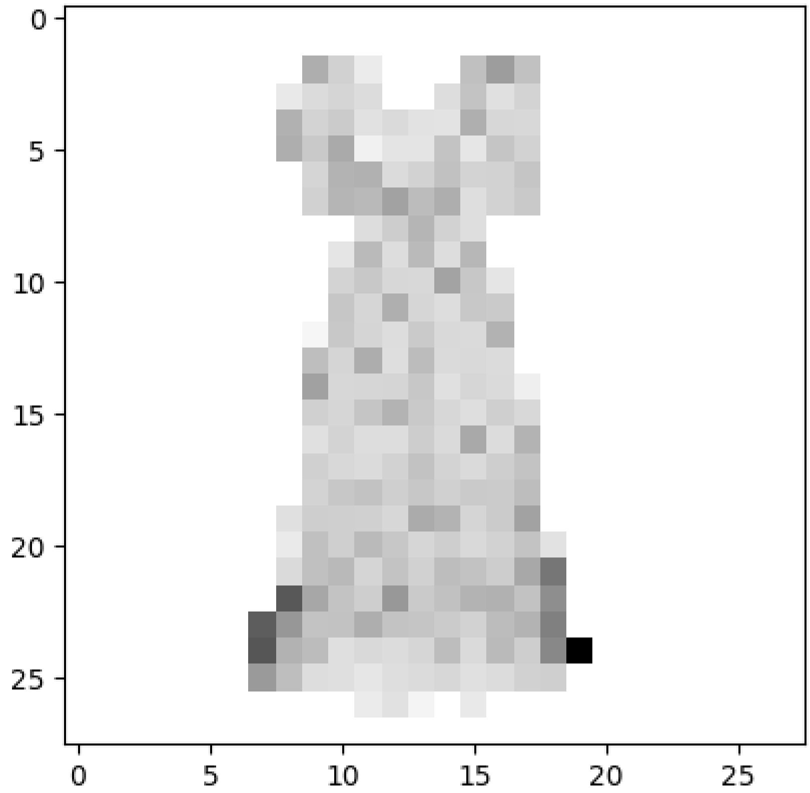
```
predict = 3. dress
wrong
2
1/1 [==============================] - 0s 21ms/step
[[2.1155523e-02 5.5381651e-08 1.3469317e-05 5.1811188e-05 2.2541390e-06
  3.0855535e-04 9.5081851e-03 6.9703523e-04 9.6825320e-01 9.8991704e-06]]
```



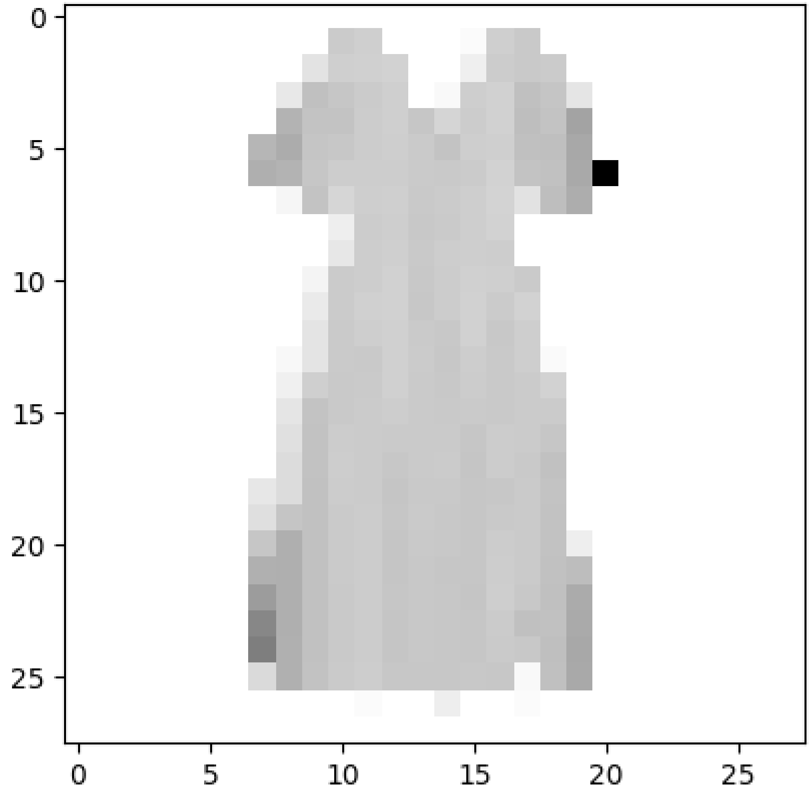
```
predict = 8. bag
wrong
2
1/1 [==============================] - 0s 22ms/step
[[1.19888775e-01 8.89562216e-05 3.63724102e-05 2.70243845e-06
  6.67500449e-03 3.31590010e-04 9.03027318e-03 8.45259365e-06
  8.63931775e-01 6.14876490e-06]]
```



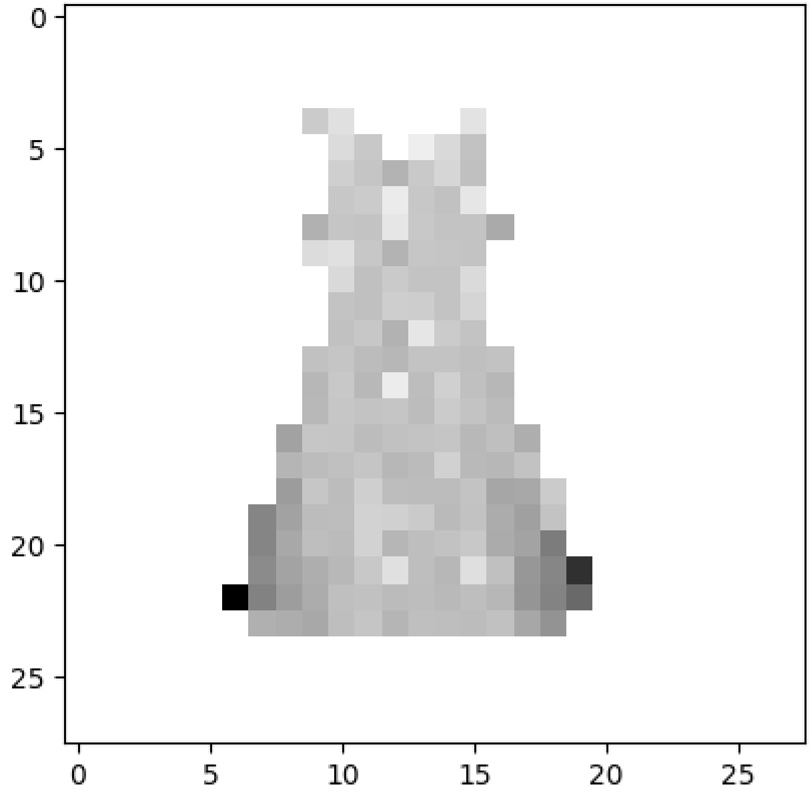
```
predict = 8. bag
wrong
3
1/1 [==============================] - 0s 20ms/step
[[5.4987108e-06 5.6545934e-05 2.5375307e-08 9.9991345e-01 2.9896938e-10
  7.8255382e-13 2.4377738e-05 6.3400374e-12 2.8920106e-11 6.2283858e-09]]
```



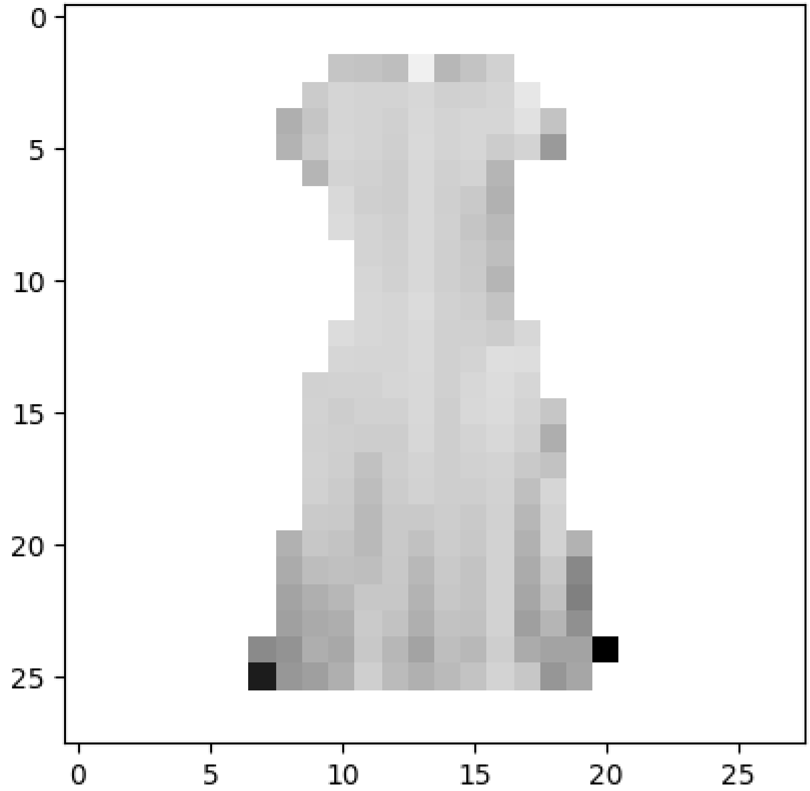
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 24ms/step
[[7.2265334e-06 1.2409975e-12 3.7205476e-09 9.9999261e-01 1.9891223e-10
  8.1008173e-15 1.4366427e-07 3.0165960e-13 1.5464117e-13 1.8476769e-13]]
```



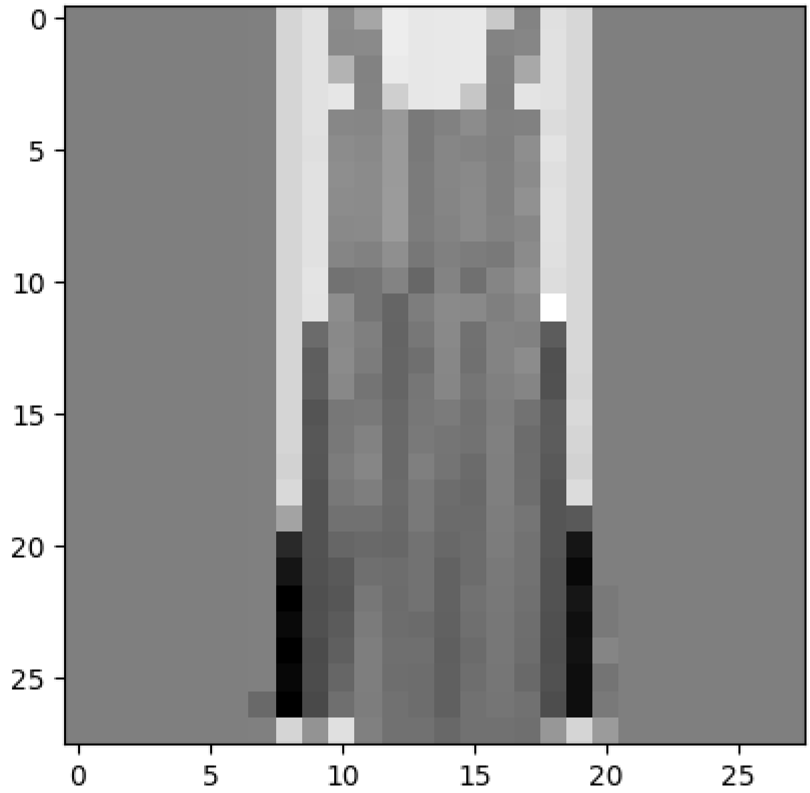
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 21ms/step
[[4.65279618e-06 2.25790282e-04 1.23068675e-08 9.99757469e-01
  2.43192400e-08 1.96133665e-10 2.72622469e-06 6.90458393e-08
  4.88617115e-06 4.32327670e-06]]
```



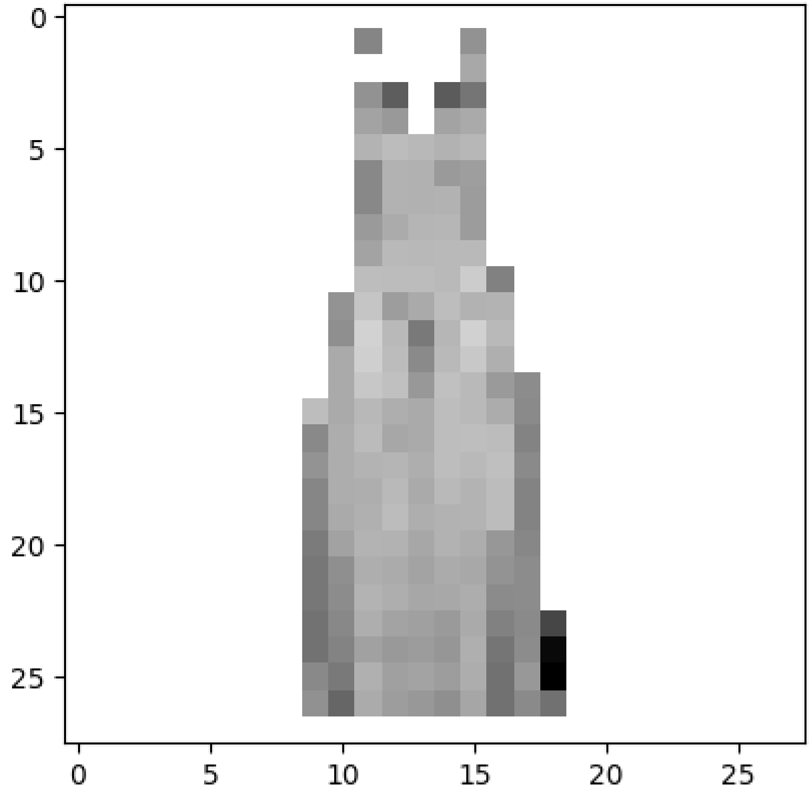
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 20ms/step
[[1.3798203e-07 1.2468764e-09 8.2357943e-08 9.9999821e-01 1.7434885e-10
  2.0618064e-13 1.5605655e-06 3.2445260e-12 1.4284609e-12 4.2042522e-11]]
```



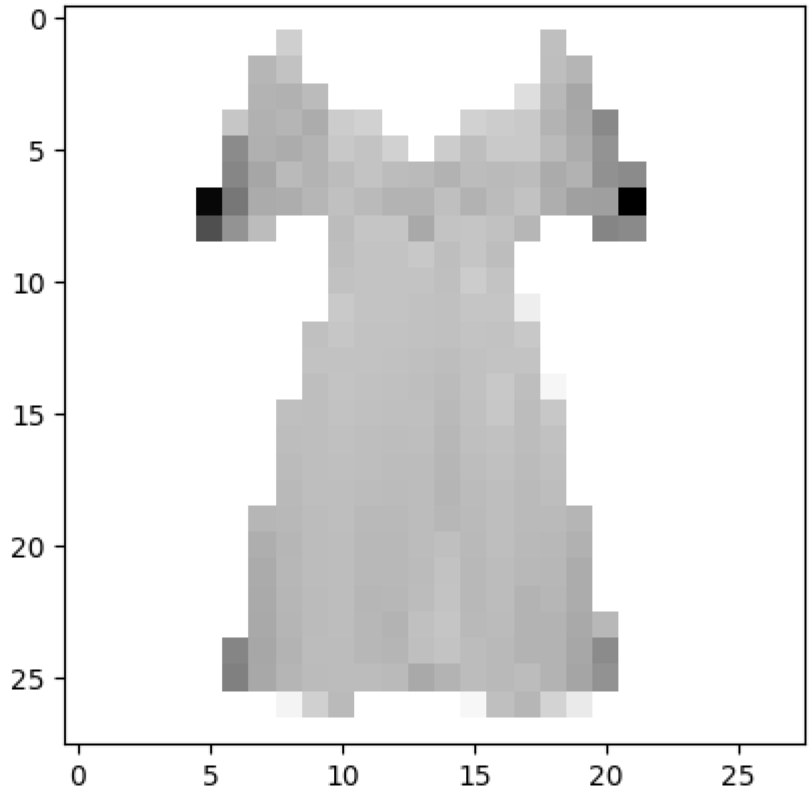
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 22ms/step
[[3.03108208e-02 3.25105153e-04 5.30564459e-03 6.76702289e-03
  5.43374158e-02 1.09612280e-04 7.38677382e-01 5.38653985e-04
  1.63518086e-01 1.10241395e-04]]
```



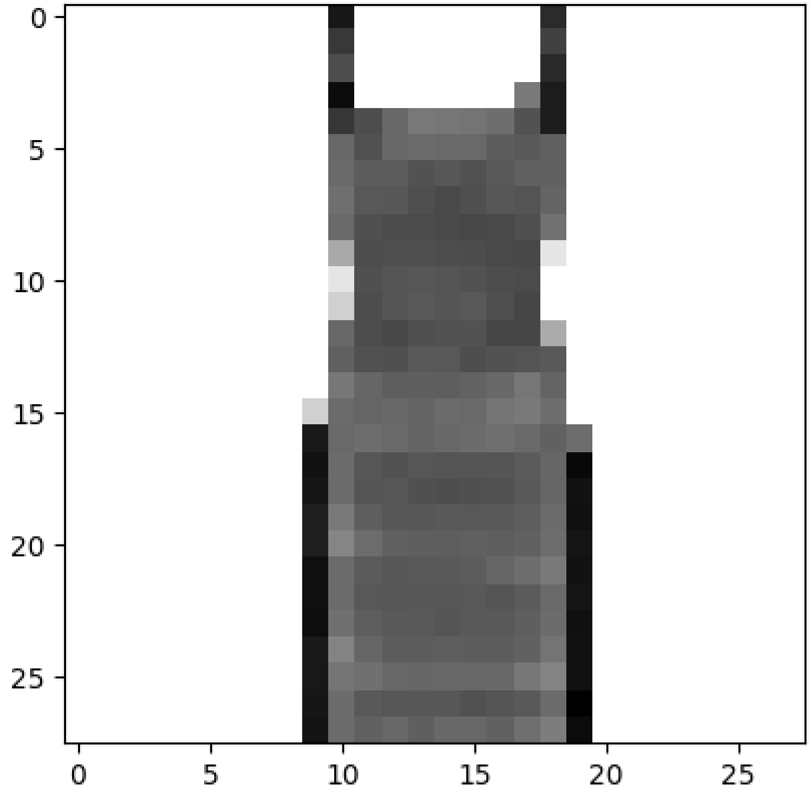
```
predict = 6. shirt
wrong
3
1/1 [==============================] - 0s 19ms/step
[[8.7375833e-05 7.0682763e-05 1.5706230e-06 9.9982953e-01 9.5398196e-09
  2.4674509e-12 1.0206374e-05 1.0540952e-10 6.1547377e-07 9.9454323e-10]]
```



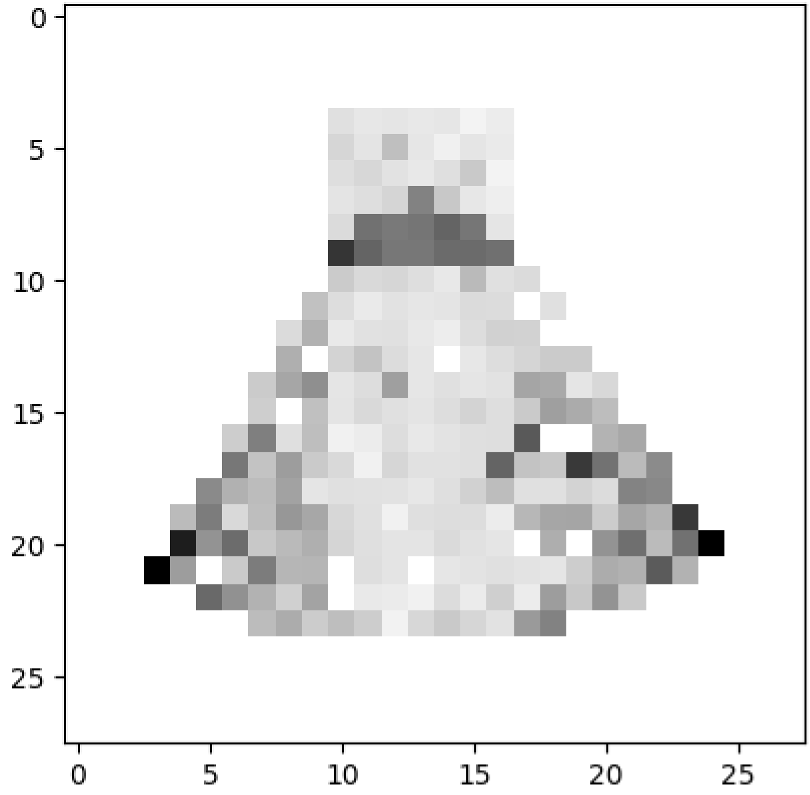
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 22ms/step
[[6.5304603e-06 7.2413338e-15 3.4188830e-10 9.9999273e-01 1.5403332e-09
  1.0452719e-16 6.8761523e-07 1.6128301e-13 1.2437264e-10 2.3870893e-13]]
```



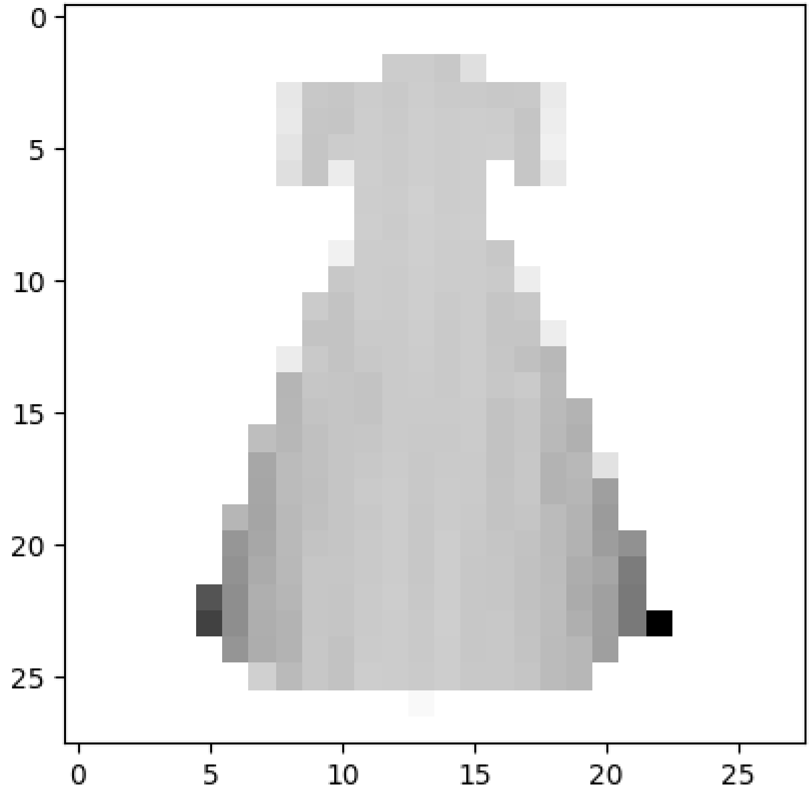
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 21ms/step
[[1.7635221e-05 2.0526777e-06 2.1616563e-07 9.9997663e-01 3.0120870e-09
  1.9585076e-09 3.5035371e-06 1.7683452e-09 3.6916128e-09 4.6105722e-08]]
```



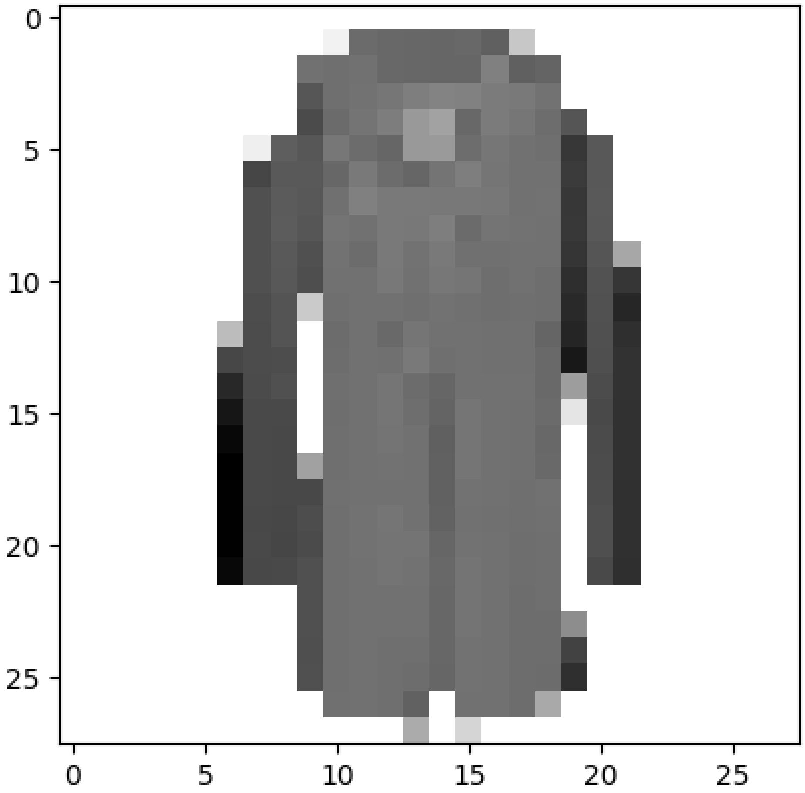
```
predict = 3. dress
correct
3
1/1 [==============================] - 0s 25ms/step
[[2.96215941e-08 4.69703053e-04 1.41200844e-11 3.54705065e-01
  8.91556112e-07 9.93219018e-02 8.80309017e-07 7.76903778e-02
  4.67781574e-01 2.95342252e-05]]
```



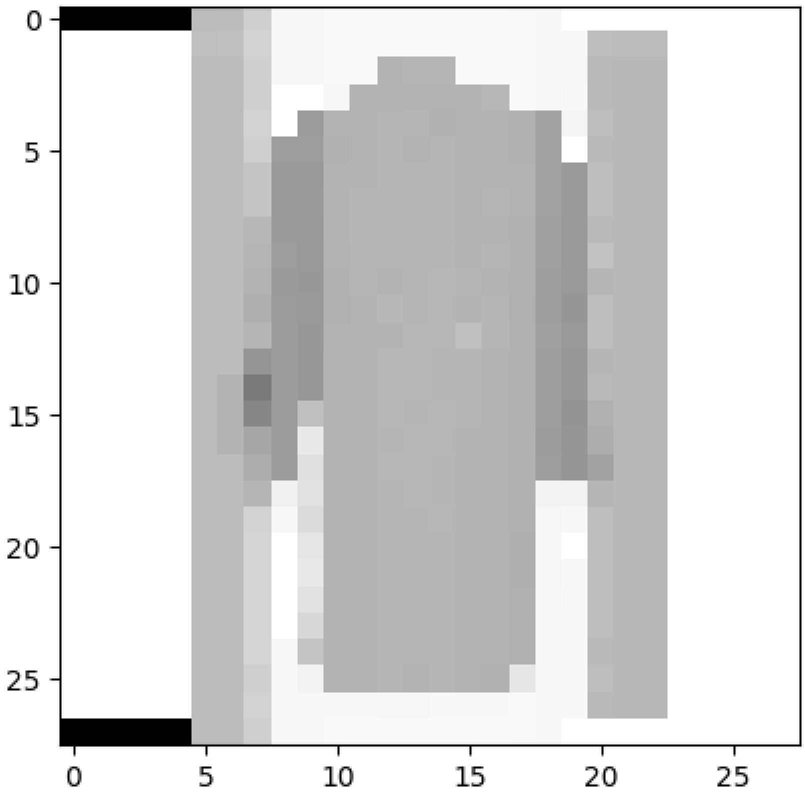
```
predict = 8. bag
wrong
3
1/1 [==============================] - 0s 28ms/step
[[1.3143017e-06 7.8489973e-07 6.1338682e-07 9.9999499e-01 3.2194144e-08
  4.3148218e-11 2.1063238e-06 1.9898426e-08 4.9438009e-10 1.3042882e-07]]
```



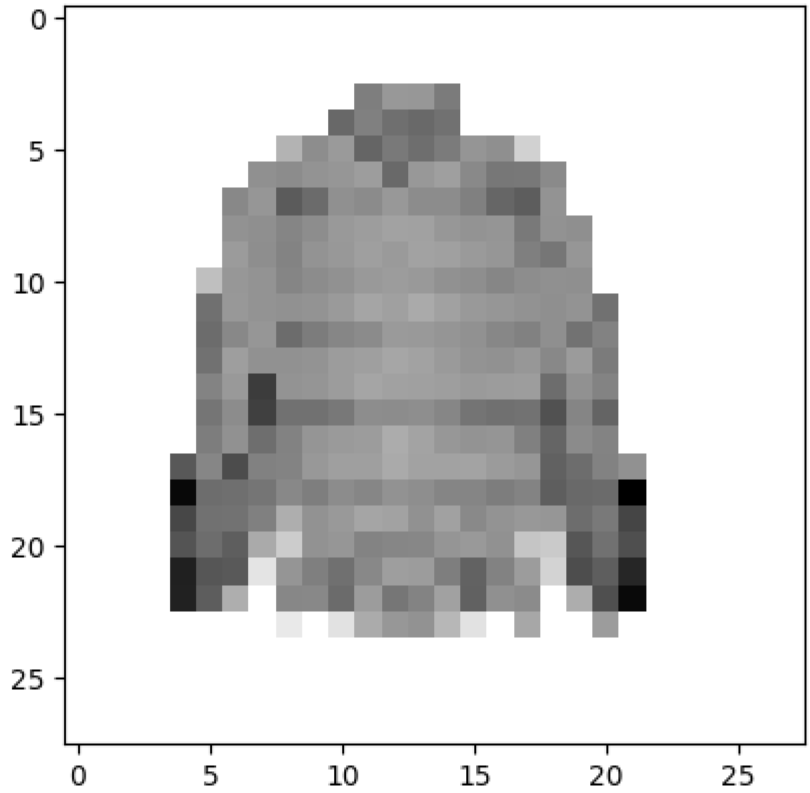
```
predict = 3. dress
correct
4
1/1 [==============================] - 0s 22ms/step
[[1.4216521e-06 8.5328846e-09 1.2676004e-01 1.3960495e-04 8.7278783e-01
  3.3980063e-10 3.0218347e-04 9.0085274e-07 7.9168185e-06 1.2421701e-07]]
```



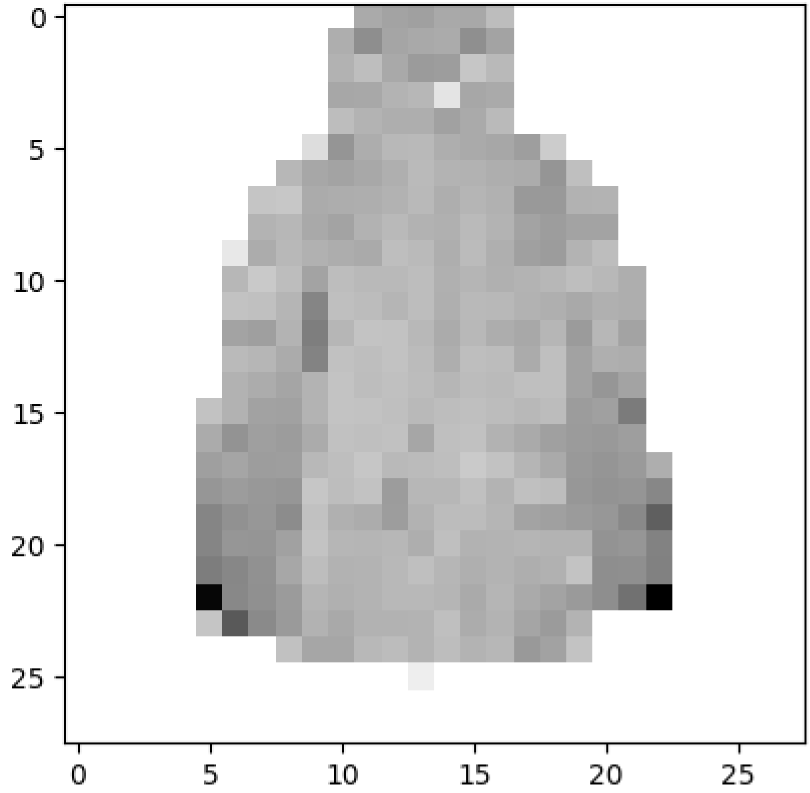
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 22ms/step
[[1.3124984e-03 2.4716970e-08 9.9182618e-01 1.5444160e-05 5.5267601e-03
  2.2308679e-08 1.3189622e-03 6.7718531e-08 3.4528576e-08 1.0382616e-08]]
```



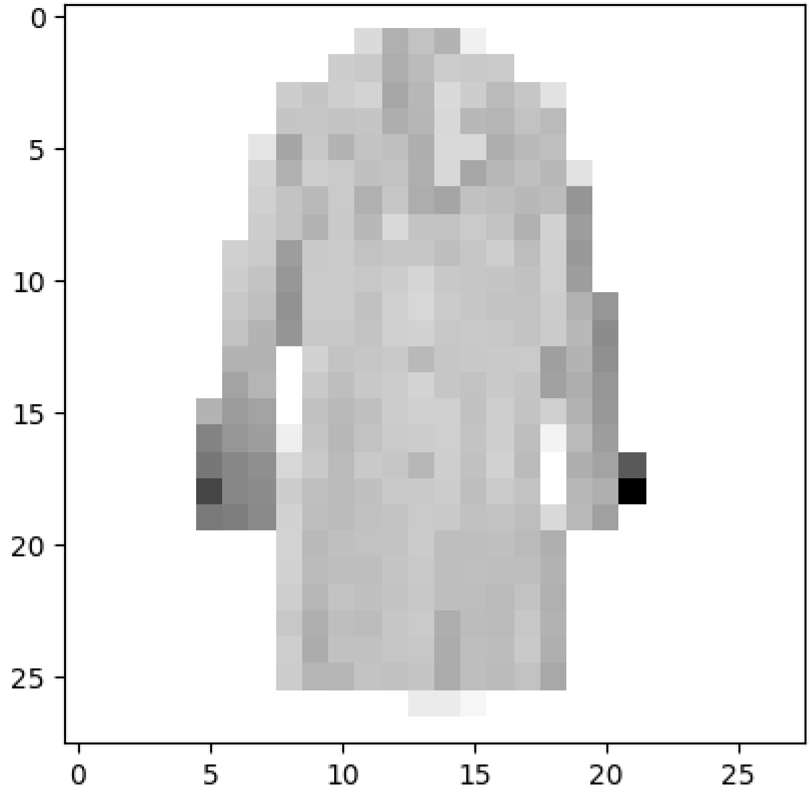
```
predict = 2. pullover
wrong
4
1/1 [==============================] - 0s 21ms/step
[[3.8121557e-03 1.5455317e-06 1.5963627e-03 9.4233010e-06 9.4475394e-01
  1.4228292e-04 4.8738062e-02 8.8720815e-04 5.7442288e-05 1.6537186e-06]]
```



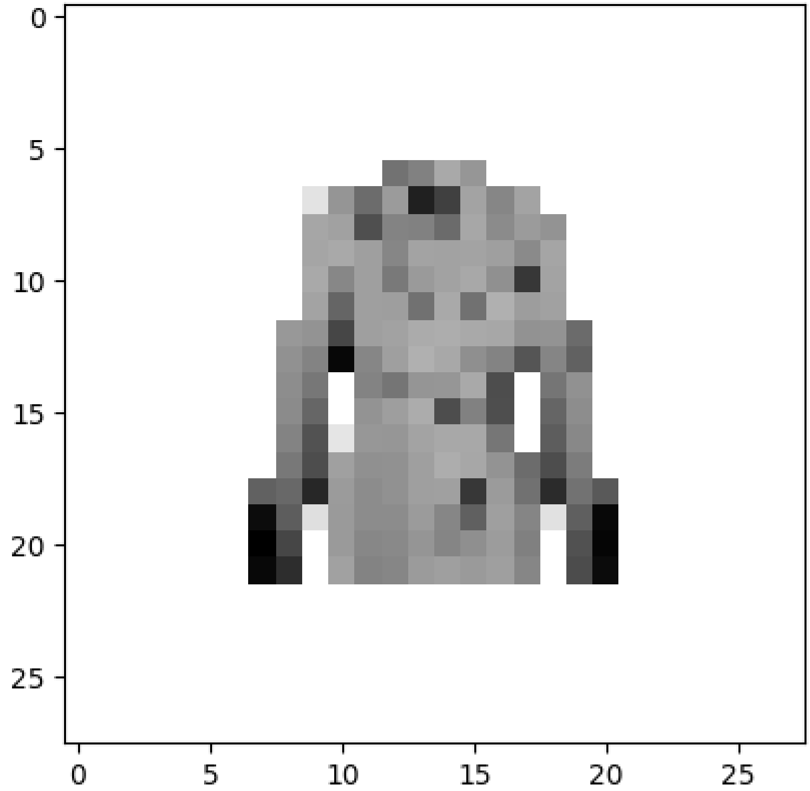
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 21ms/step
[[1.3563292e-09 2.2634952e-10 1.8324562e-04 1.0205872e-07 9.9981290e-01
  5.6145219e-12 3.8266953e-06 2.7210528e-10 5.1814369e-11 1.7457175e-10]]
```



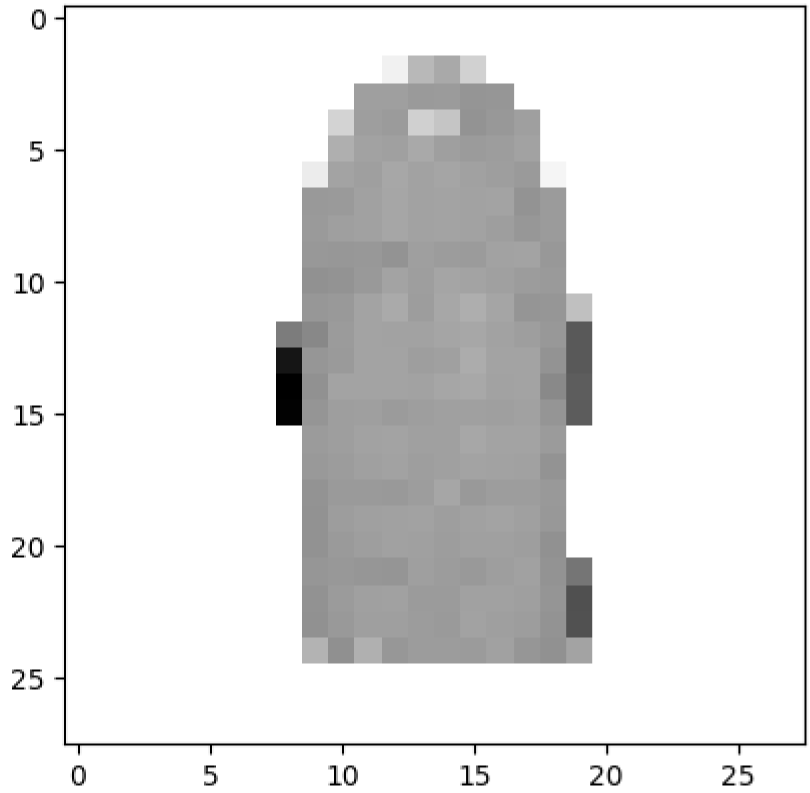
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 21ms/step
[[2.5565516e-08 1.3478627e-13 3.1237956e-05 5.0837370e-03 9.9485576e-01
  7.3392389e-14 2.9135977e-05 1.0498293e-08 7.7951841e-09 3.3502662e-11]]
```



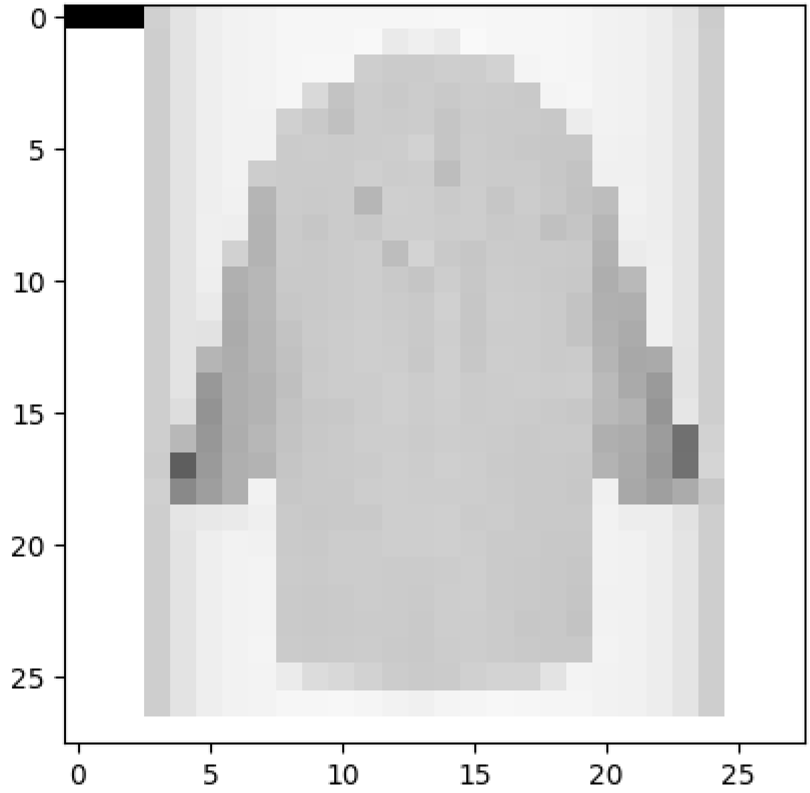
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 21ms/step
[[1.1416792e-01 3.6398433e-02 3.4337656e-05 8.2443434e-01 7.2770678e-03
  1.0480717e-02 6.4779404e-03 1.2188416e-04 5.8965530e-04 1.7749464e-05]]
```



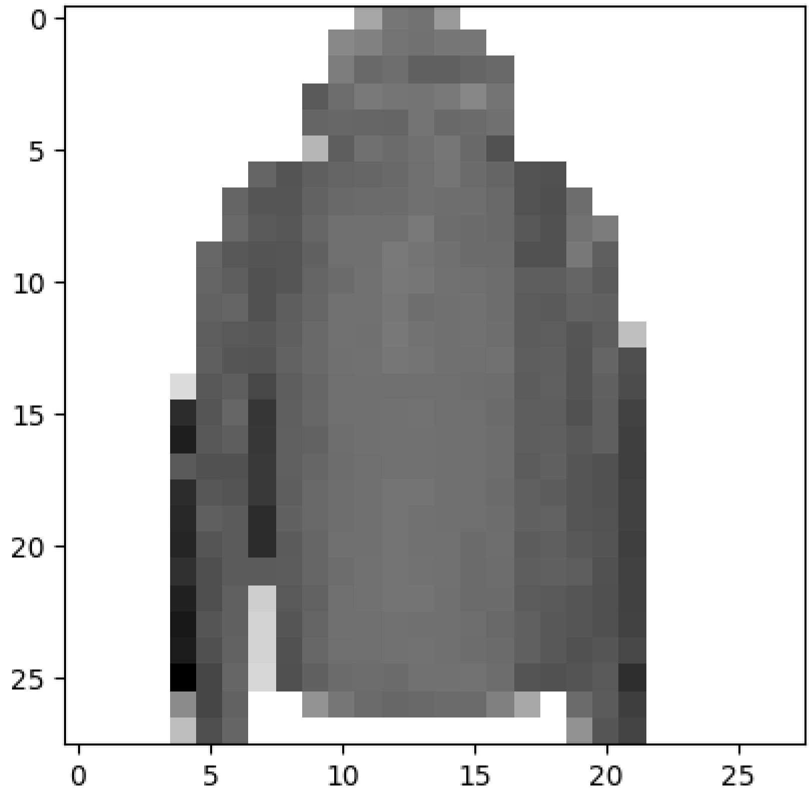
```
predict = 3. dress
wrong
4
1/1 [==============================] - 0s 22ms/step
[[2.8116618e-05 1.2637808e-03 7.9319230e-05 1.7486633e-01 8.2353908e-01
  1.7602723e-08 2.1993673e-04 1.6216823e-08 3.4646007e-06 4.2808654e-09]]
```



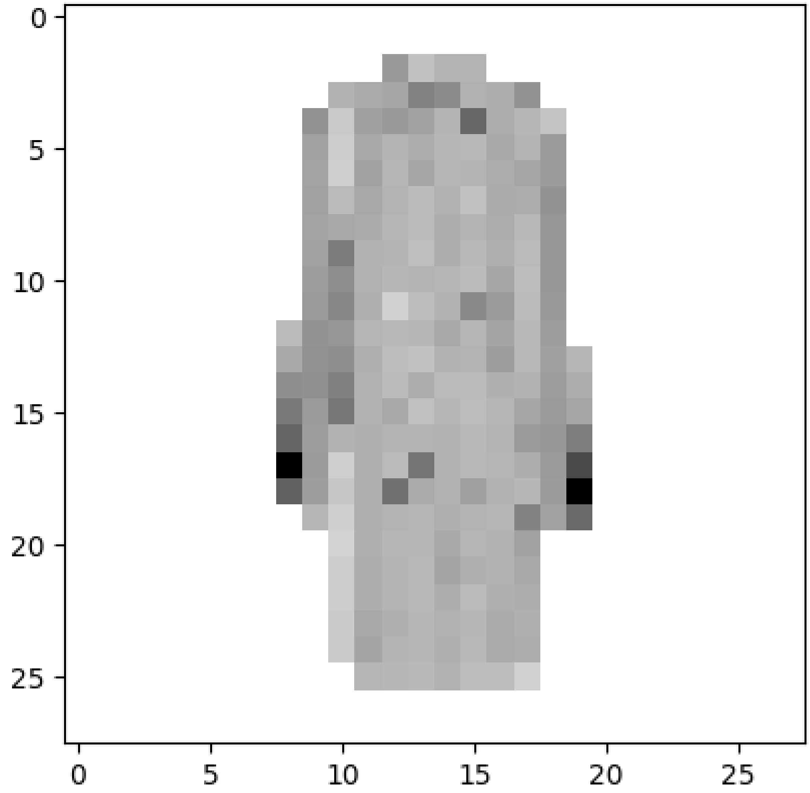
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 22ms/step
[[3.78651964e-03 1.16116972e-07 3.46398763e-02 1.82888117e-02
  8.11107934e-01 6.84878216e-07 1.31996945e-01 1.19833385e-04
  5.79575317e-05 1.34119250e-06]]
```



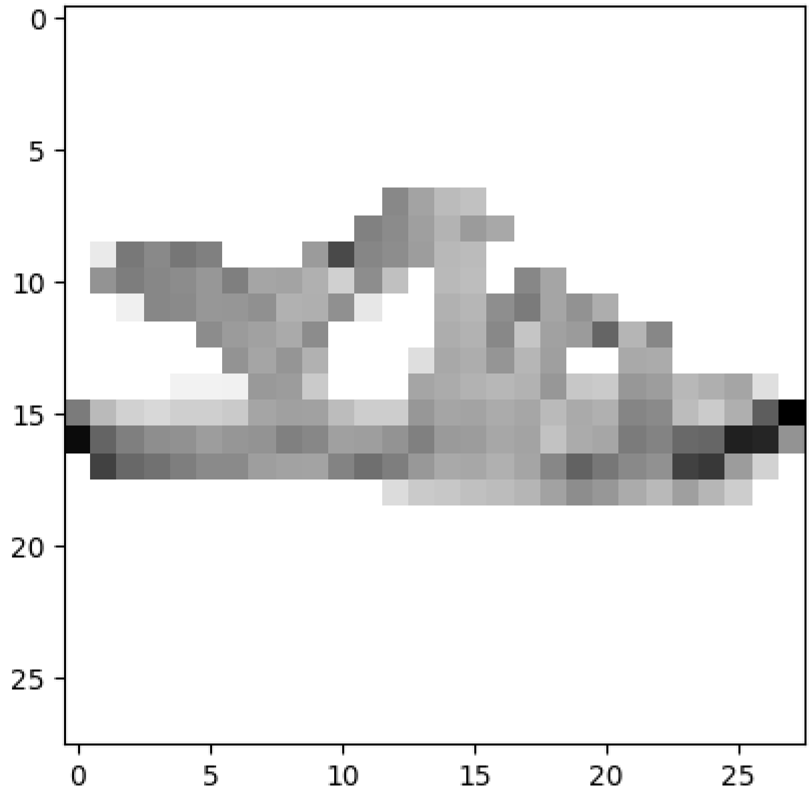
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 22ms/step
[[1.2925314e-05 2.0734749e-06 1.9950259e-03 2.3909336e-06 9.9778229e-01
  9.8314229e-07 1.8747388e-04 1.0780683e-05 3.0083895e-06 3.1018531e-06]]
```



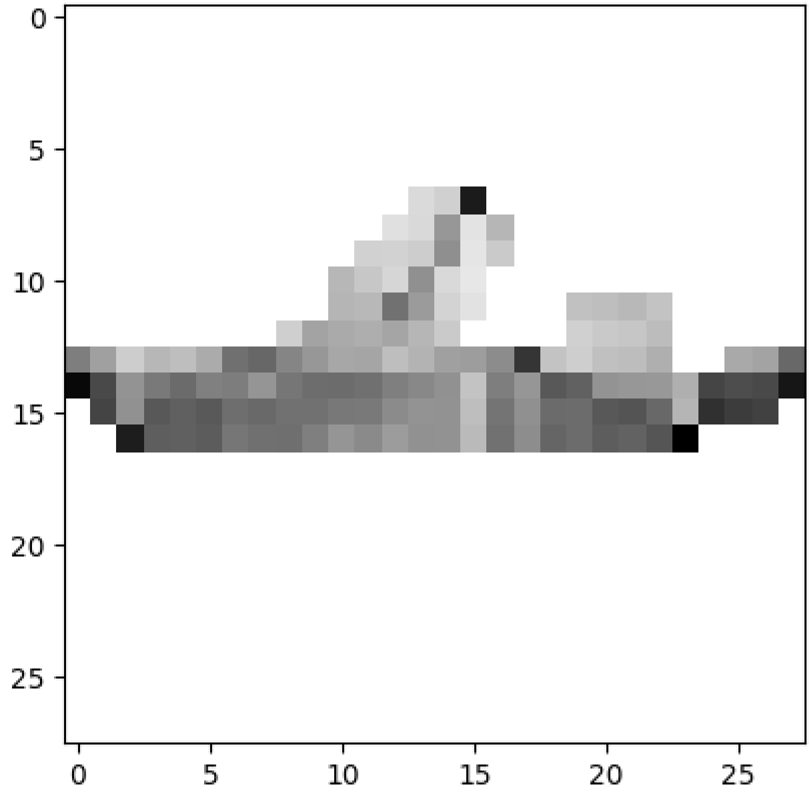
```
predict = 4. coat
correct
4
1/1 [==============================] - 0s 21ms/step
[[2.2136106e-05 3.5676153e-06 4.8930406e-07 9.3239349e-01 6.3854948e-02
  4.2071230e-10 3.7254125e-03 1.0864452e-09 5.8023732e-09 1.2702332e-10]]
```



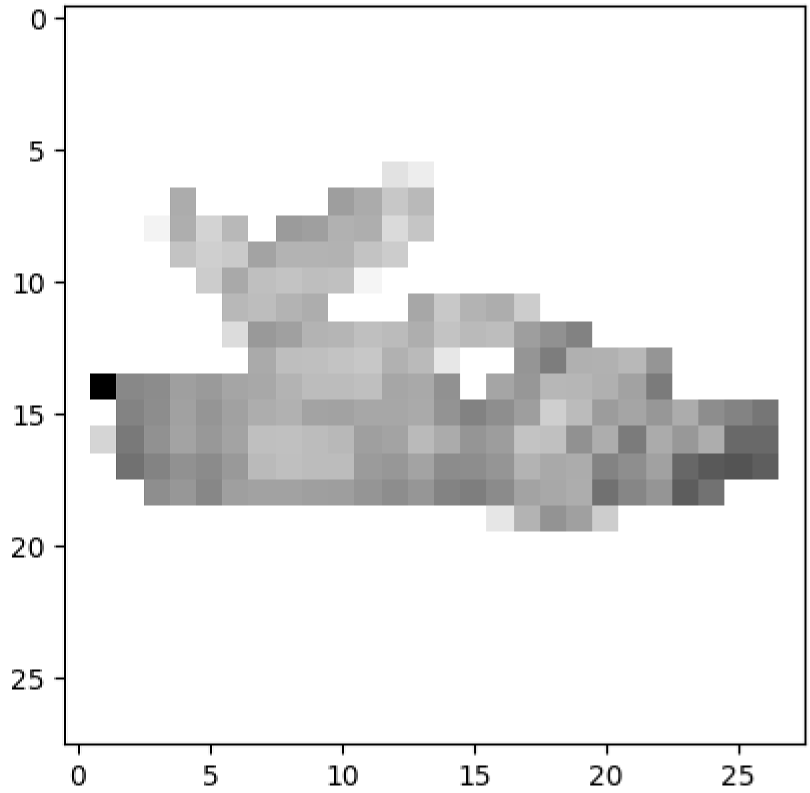
```
predict = 3. dress
wrong
5
1/1 [==============================] - 0s 21ms/step
[[6.8799239e-10 8.0324298e-12 2.3463056e-10 3.4733000e-18 7.9338042e-17
  7.9626986e-04 1.0584761e-08 2.8125025e-04 9.9892199e-01 5.0698412e-07]]
```



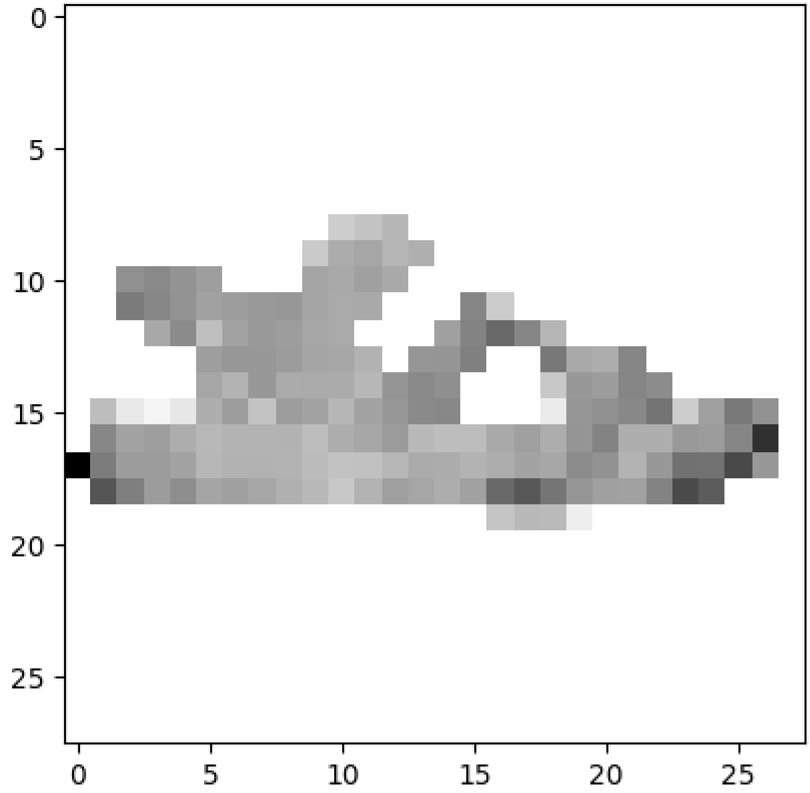
```
predict = 8. bag
wrong
5
1/1 [==============================] - 0s 22ms/step
[[1.4524912e-10 7.6200271e-13 2.3460395e-10 6.2159796e-12 7.0732245e-14
  2.8885620e-07 6.7640658e-09 9.9929261e-01 1.5610171e-07 7.0692215e-04]]
```



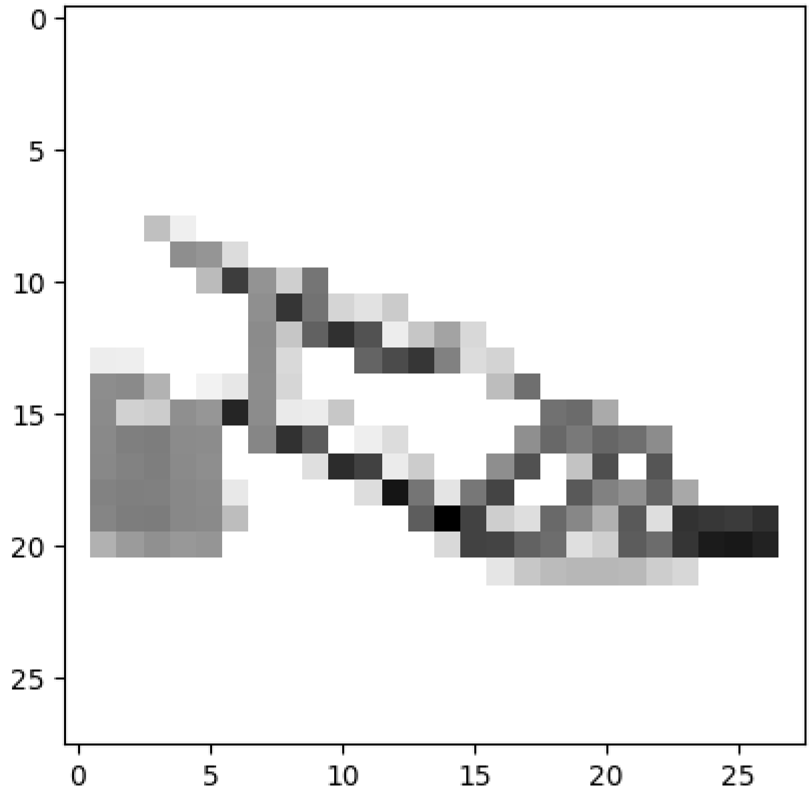
```
predict = 7. sneaker
wrong
5
1/1 [==============================] - 0s 21ms/step
[[3.1295947e-06 8.7244127e-12 9.7098882e-06 1.8547167e-12 1.8588267e-10
  4.7606468e-01 4.6775713e-06 4.6261394e-01 6.1281804e-02 2.2118315e-05]]
```



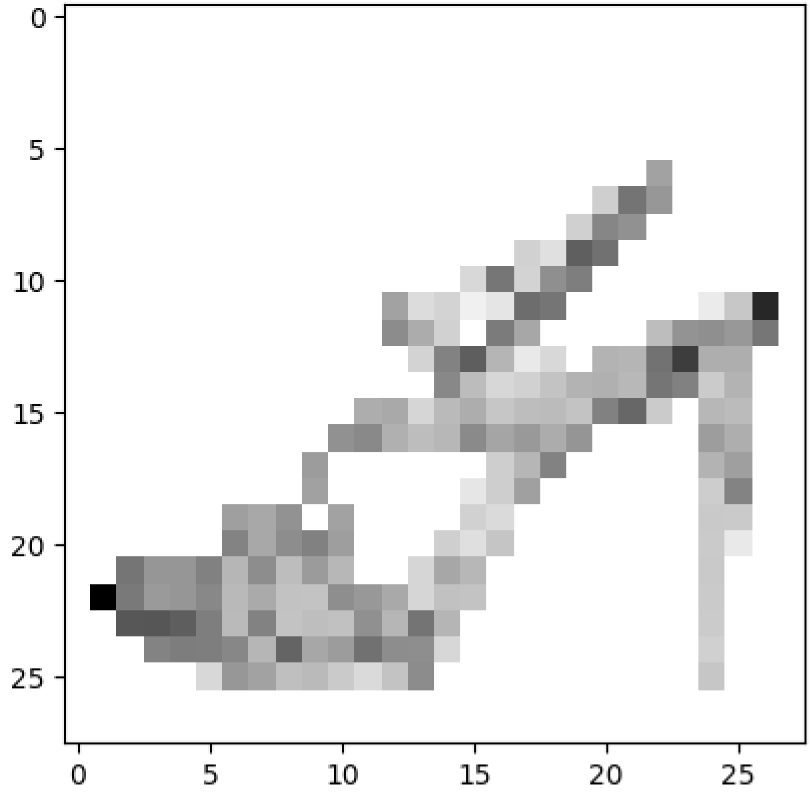
```
predict = 5. sandal
correct
5
1/1 [==============================] - 0s 21ms/step
[[3.5595042e-09 1.3668163e-11 1.1968696e-06 1.7228042e-13 1.0647759e-15
  2.8931312e-03 6.5025713e-05 9.7167766e-01 2.5359925e-02 3.1326524e-06]]
```



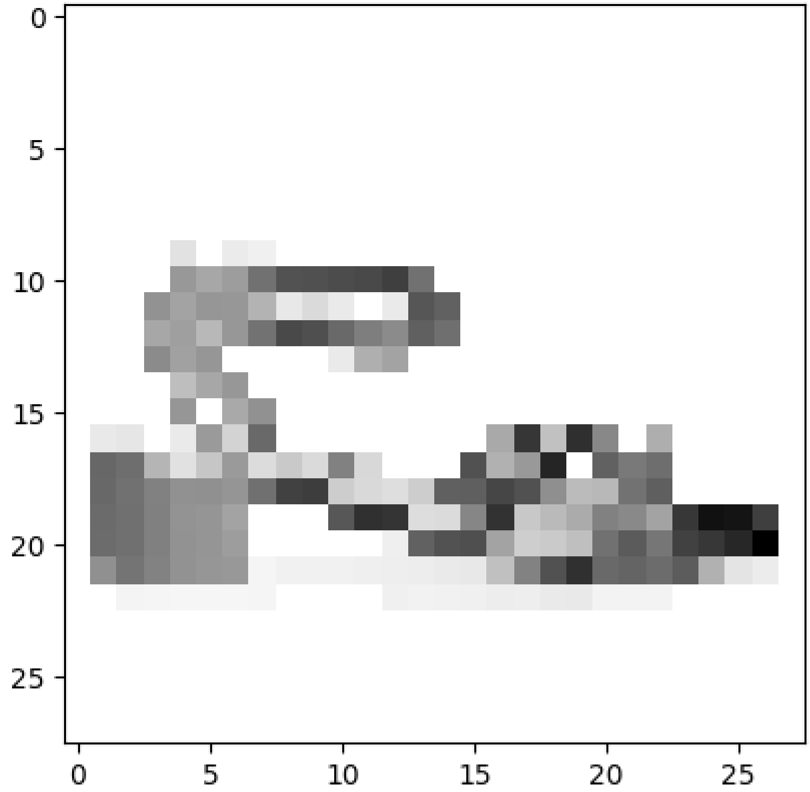
```
predict = 7. sneaker
wrong
5
1/1 [==============================] - 0s 20ms/step
[[1.0371501e-14 2.4671901e-15 1.0727564e-17 5.6559839e-18 3.9209623e-22
  1.0000000e+00 1.0787587e-12 6.8997315e-11 5.3328581e-11 3.9344350e-13]]
```



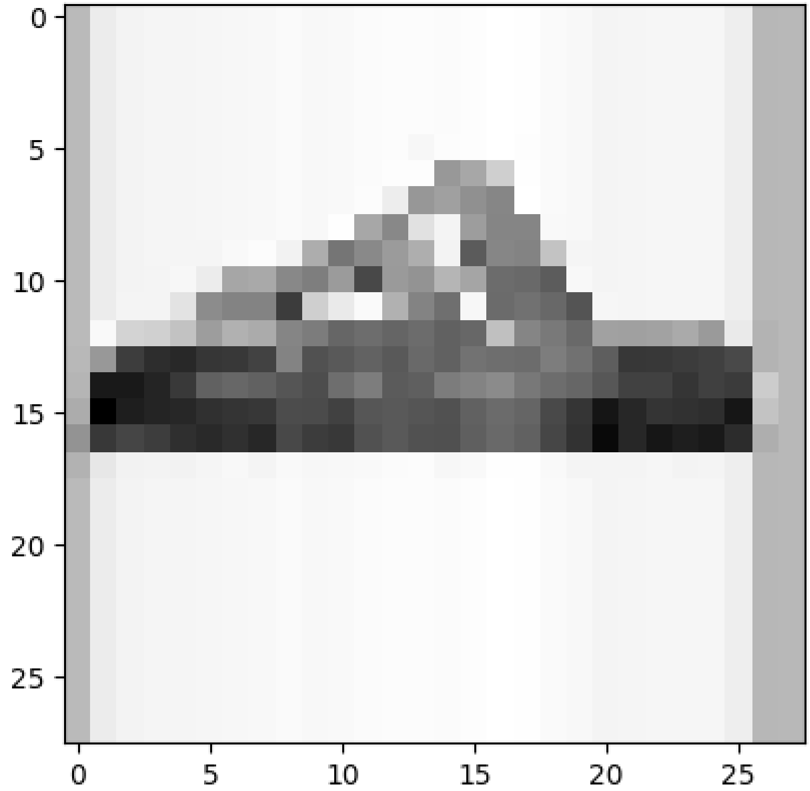
```
predict = 5. sandal
correct
5
1/1 [==============================] - 0s 20ms/step
[[4.0927775e-14 6.9806851e-12 4.6282715e-13 7.1147463e-11 3.3531431e-18
  9.9999976e-01 3.8714865e-13 5.4986238e-08 4.9454109e-13 1.9084635e-07]]
```



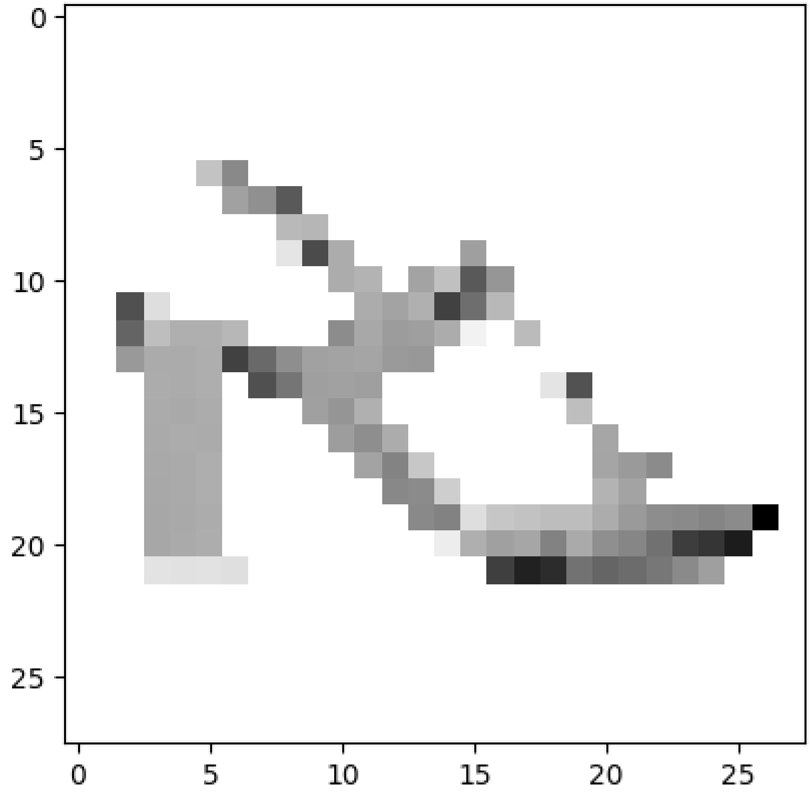
```
predict = 5. sandal
correct
5
1/1 [==============================] - 0s 21ms/step
[[2.0426825e-07 7.1390810e-10 1.0754535e-07 1.4440428e-11 3.5934551e-21
  9.9999964e-01 6.0170202e-10 3.6830889e-09 3.4106981e-11 1.0259434e-09]]
```



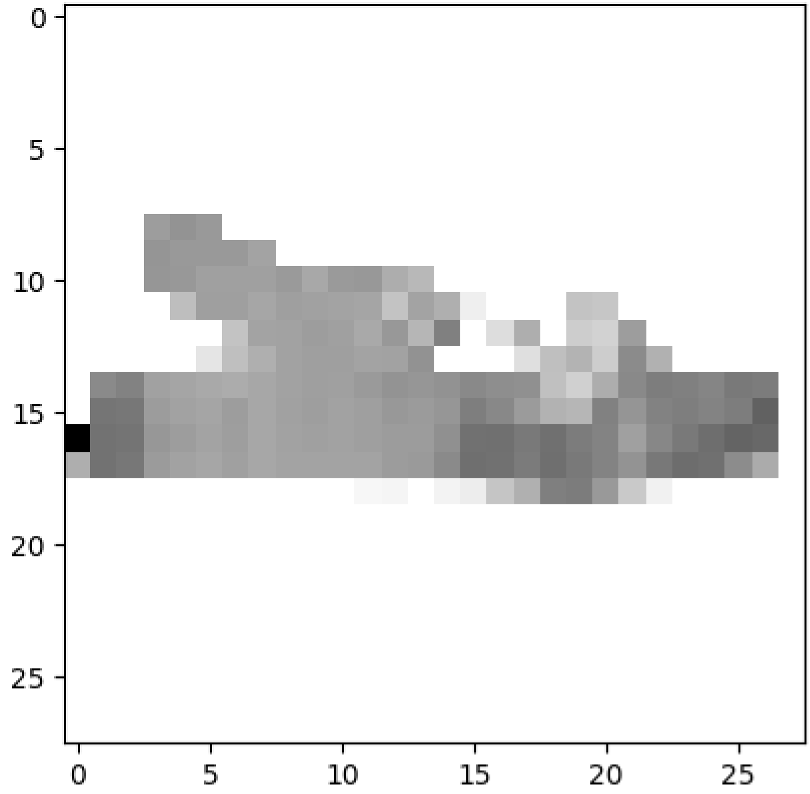
```
predict = 5. sandal
correct
5
1/1 [==============================] - 0s 22ms/step
[[3.5504974e-02 1.6286892e-06 2.5384934e-03 5.3131544e-08 6.1566816e-08
  2.4609579e-04 3.3788430e-04 9.6067208e-01 3.9797998e-04 3.0084670e-04]]
```



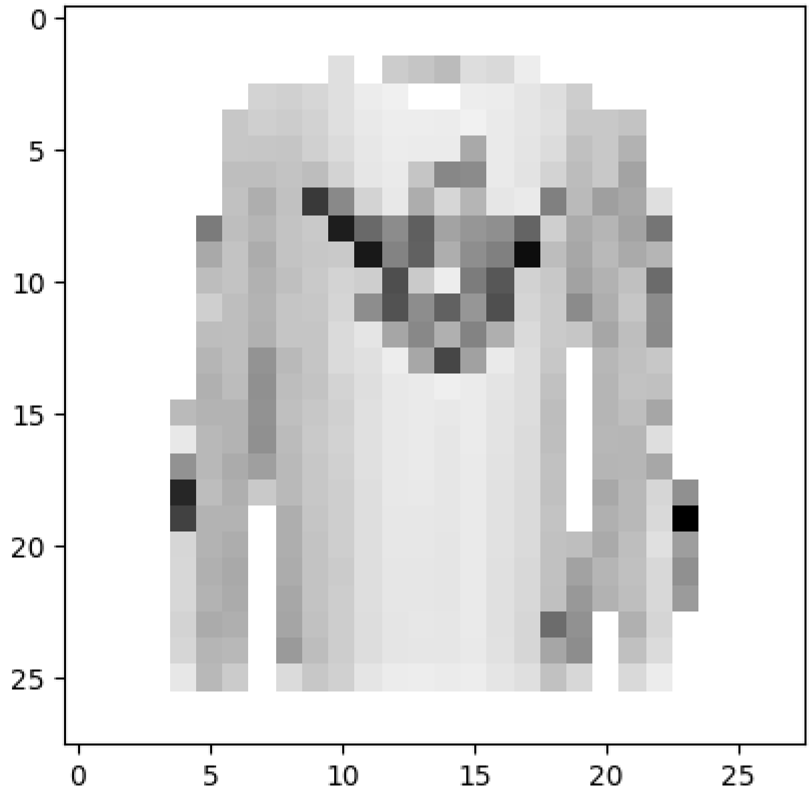
```
predict = 7. sneaker
wrong
5
1/1 [==============================] - 0s 20ms/step
[[1.7033432e-04 9.8832627e-04 1.1169542e-02 6.7361805e-09 2.1122387e-10
  1.4678367e-05 9.4390708e-01 2.3069972e-05 4.3726936e-02 6.2275873e-08]]
```



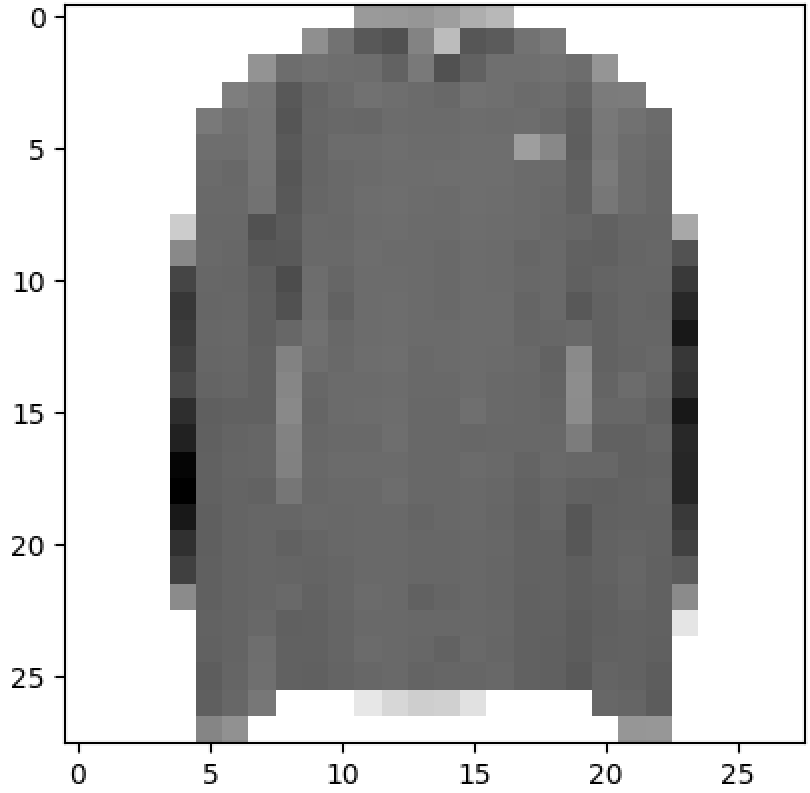
```
predict = 6. shirt
wrong
5
1/1 [==============================] - 0s 24ms/step
[[5.7680032e-04 1.0235583e-09 7.1372272e-04 2.1558327e-13 1.9445177e-10
  6.7931128e-01 3.9993152e-05 2.1229114e-04 3.1914496e-01 9.6989515e-07]]
```



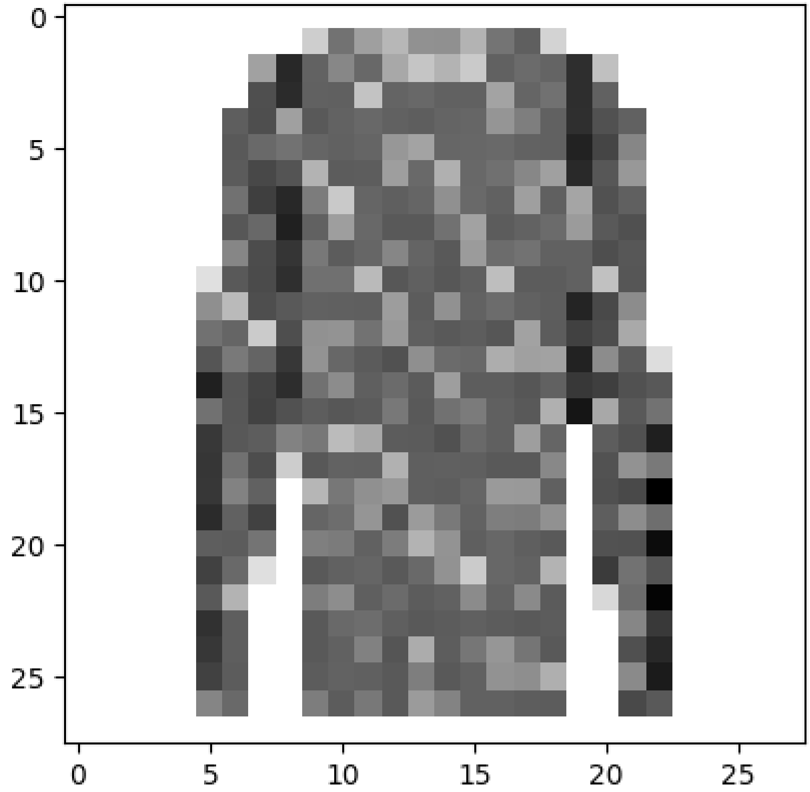
```
predict = 5. sandal
correct
6
1/1 [==============================] - 0s 21ms/step
[[8.1269136e-05 1.5314826e-06 9.7467083e-01 9.6789910e-04 3.1928701e-06
  9.2148366e-06 2.3929715e-02 2.7938143e-04 5.5048575e-05 1.9354916e-06]]
```



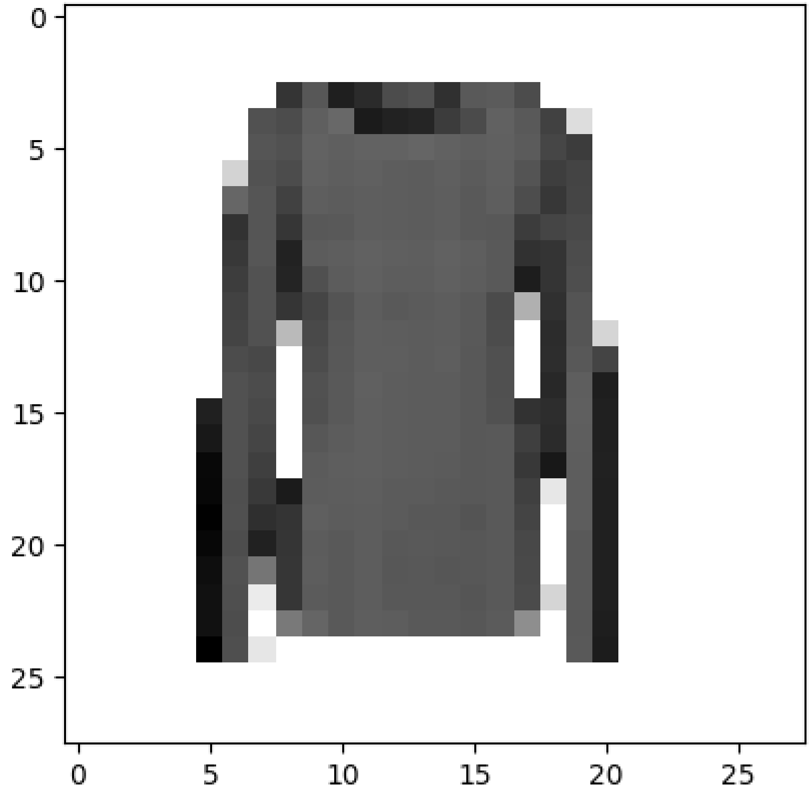
```
predict = 2. pullover
wrong
6
1/1 [==============================] - 0s 20ms/step
[[8.4364915e-04 2.1557906e-04 3.6591798e-01 8.5717831e-03 5.6600404e-01
  1.2224865e-05 5.6693394e-02 4.5988600e-05 1.6534658e-03 4.1865751e-05]]
```



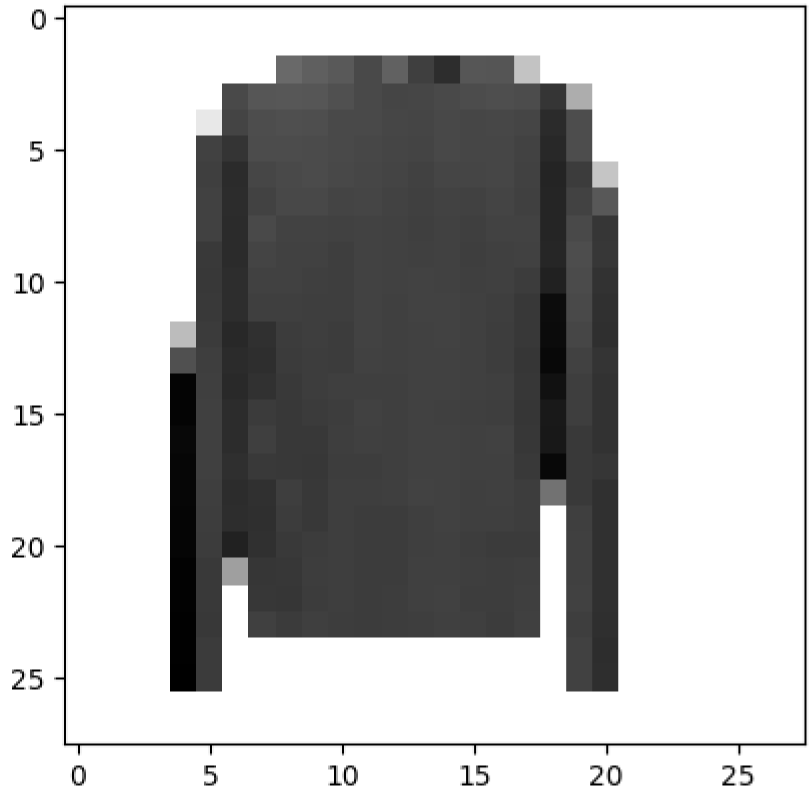
```
predict = 4. coat
wrong
6
1/1 [==============================] - 0s 21ms/step
[[6.0631341e-04 7.4678688e-08 8.3860421e-01 1.2757447e-01 3.1825695e-03
  1.0815431e-09 3.0027634e-02 5.0734965e-08 4.6975724e-06 7.1672166e-09]]
```



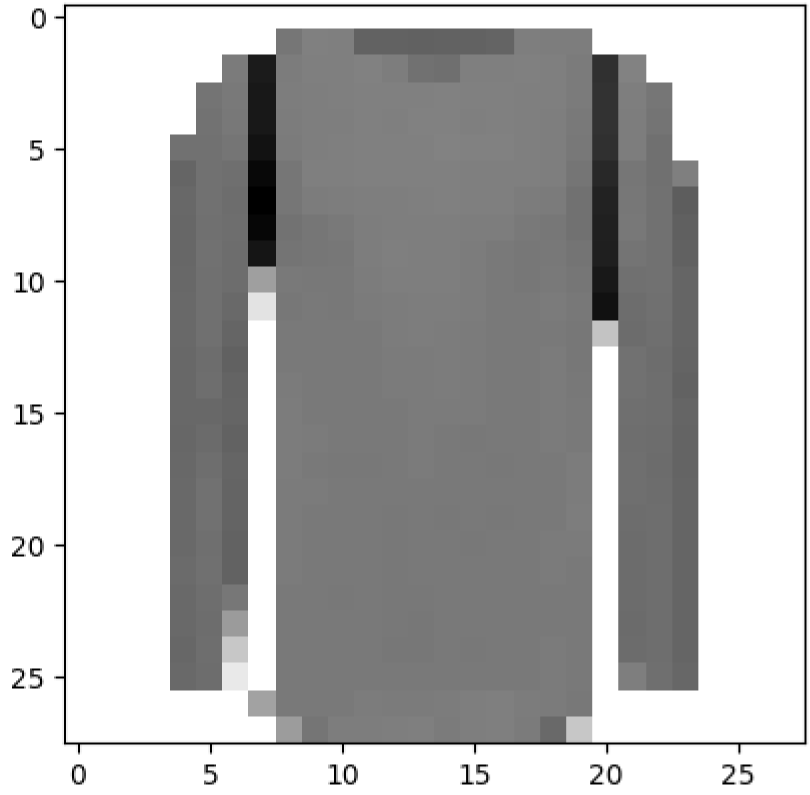
```
predict = 2. pullover
wrong
6
1/1 [==============================] - 0s 23ms/step
[[1.7526250e-05 5.2363093e-11 1.1700129e-04 2.2304561e-03 9.9339396e-01
  4.1185606e-09 4.2326152e-03 1.9340463e-08 8.3926589e-06 4.9131366e-09]]
```



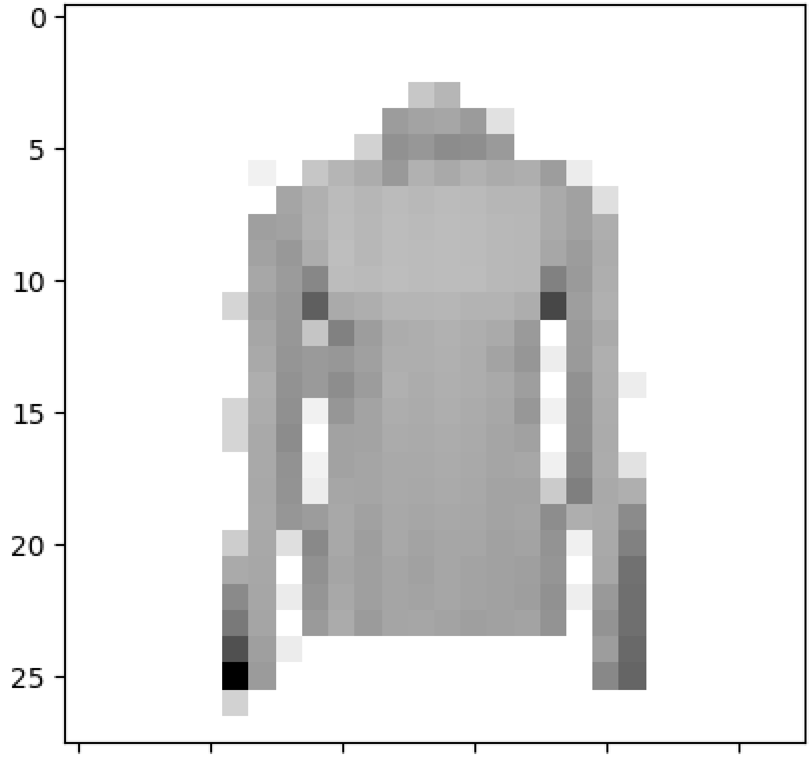
```
predict = 4. coat
wrong
6
1/1 [==============================] - 0s 20ms/step
[[2.1257612e-04 2.7600893e-06 1.6896768e-01 4.1141943e-03 7.0883548e-01
  6.5932213e-06 1.1763692e-01 1.4762082e-05 2.0244517e-04 6.5786498e-06]]
```



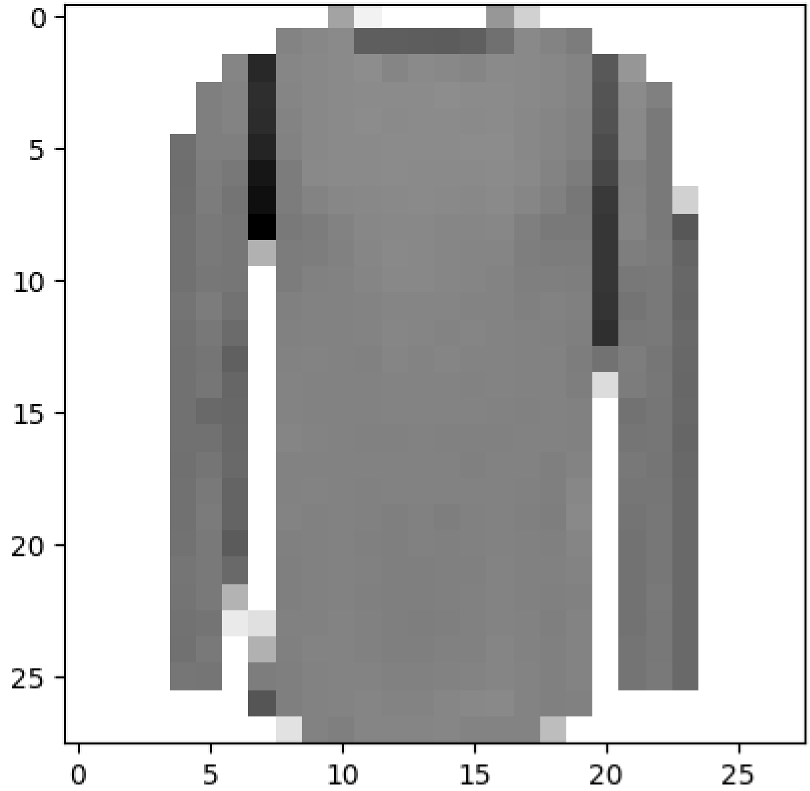
```
predict = 4. coat
wrong
6
1/1 [==============================] - 0s 21ms/step
[[6.4220699e-06 5.1309686e-11 9.9998510e-01 2.8627460e-07 1.3334663e-06
  2.0511057e-14 6.8879103e-06 7.9670437e-12 1.2307280e-11 7.5465101e-13]]
```



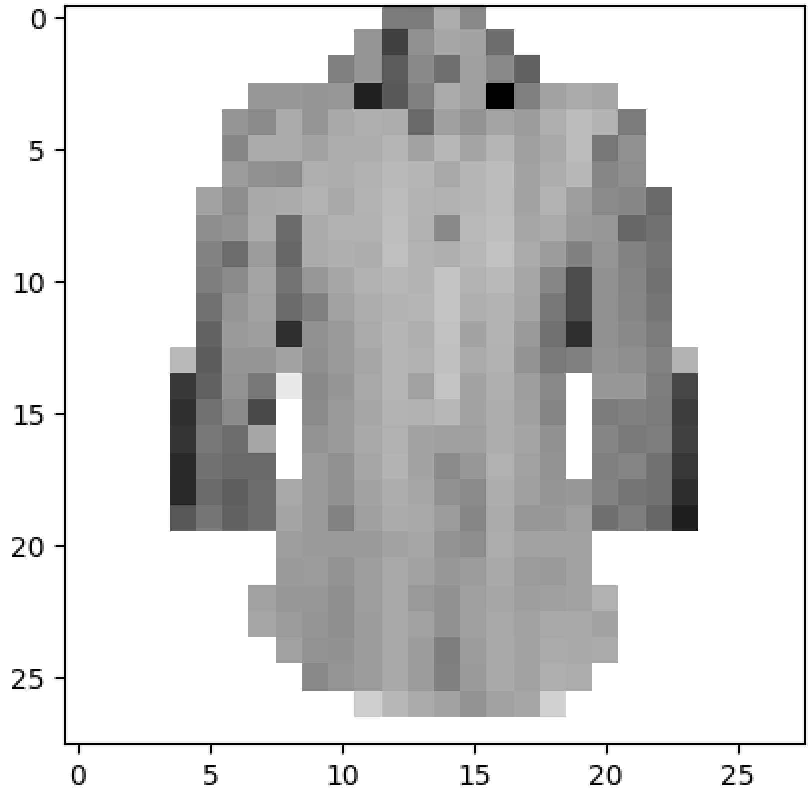
```
predict = 2. pullover
wrong
6
1/1 [==============================] - 0s 21ms/step
[[5.3596200e-04 4.0500713e-06 9.0279598e-03 7.5241720e-04 1.9192906e-01
  1.8037478e-03 7.9508770e-01 2.0915977e-05 8.1893633e-04 1.9140025e-05]]
```



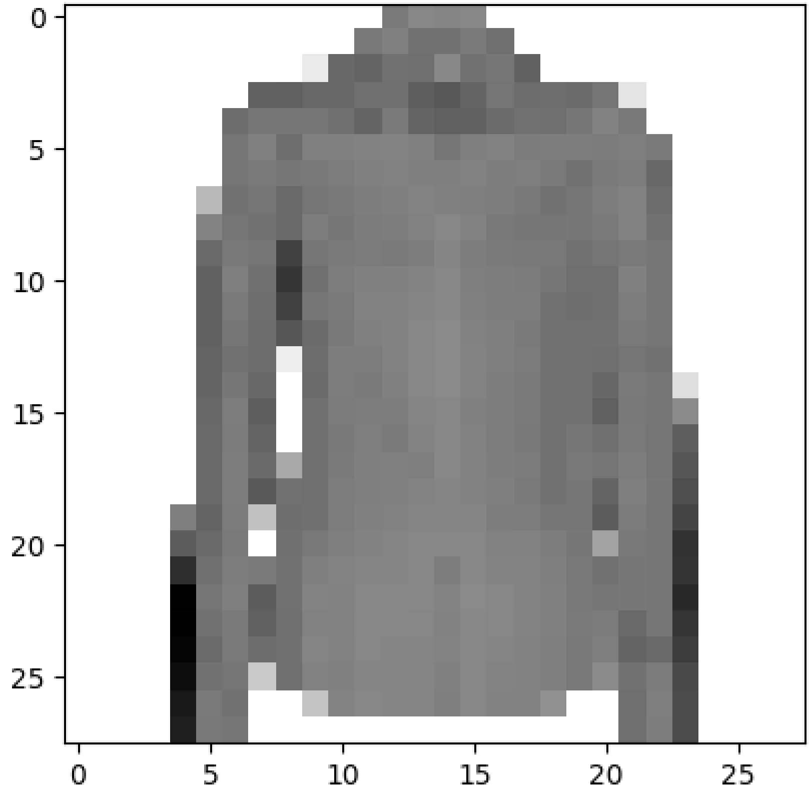
```
predict = 6. shirt
correct
6
1/1 [==============================] - 0s 20ms/step
[[2.6903868e-05 1.2605224e-09 9.9989283e-01 2.1965220e-06 5.5216689e-05
  1.0768219e-12 2.2834041e-05 1.2060213e-10 3.6327652e-09 3.6174806e-11]]
```



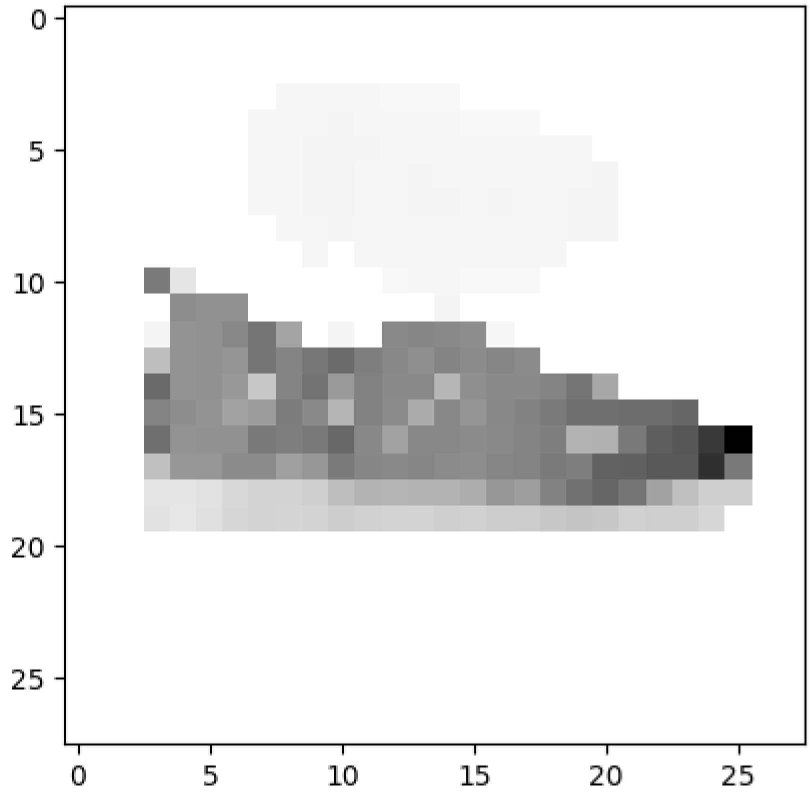
```
predict = 2. pullover
wrong
6
1/1 [==============================] - 0s 21ms/step
[[1.0192563e-03 1.6938058e-13 8.2758015e-06 1.8971188e-06 2.6011307e-02
  1.8708327e-16 9.7295928e-01 3.6340456e-13 8.5410170e-18 2.3694254e-15]]
```



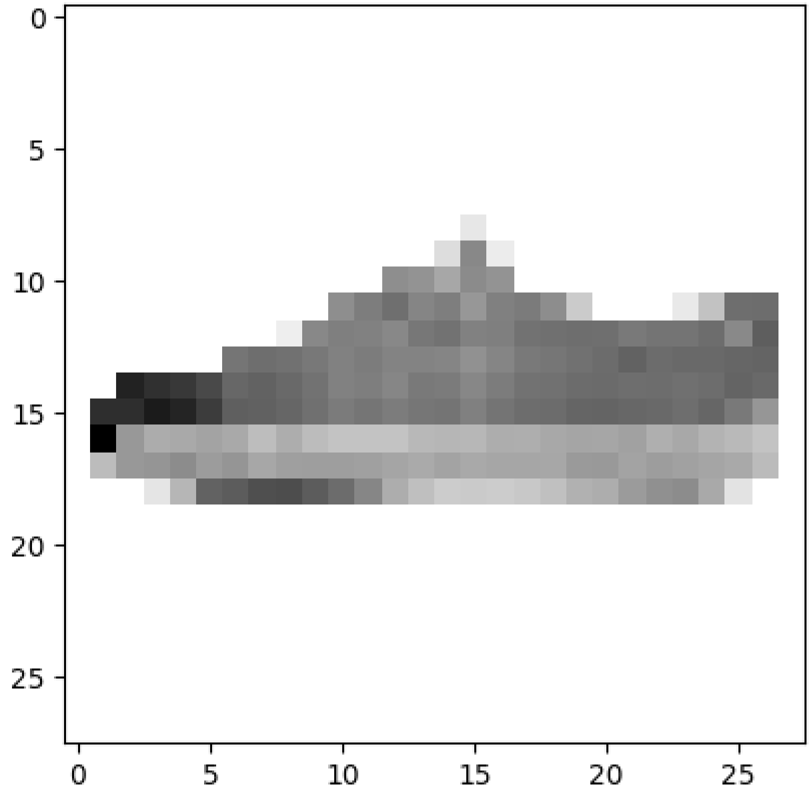
```
predict = 6. shirt
correct
6
1/1 [==============================] - 0s 20ms/step
[[6.8698771e-04 4.8297211e-06 3.0770794e-01 1.8444797e-07 3.6659932e-01
  9.7094537e-09 3.2499164e-01 6.4971546e-06 5.7970448e-07 2.0529662e-06]]
```



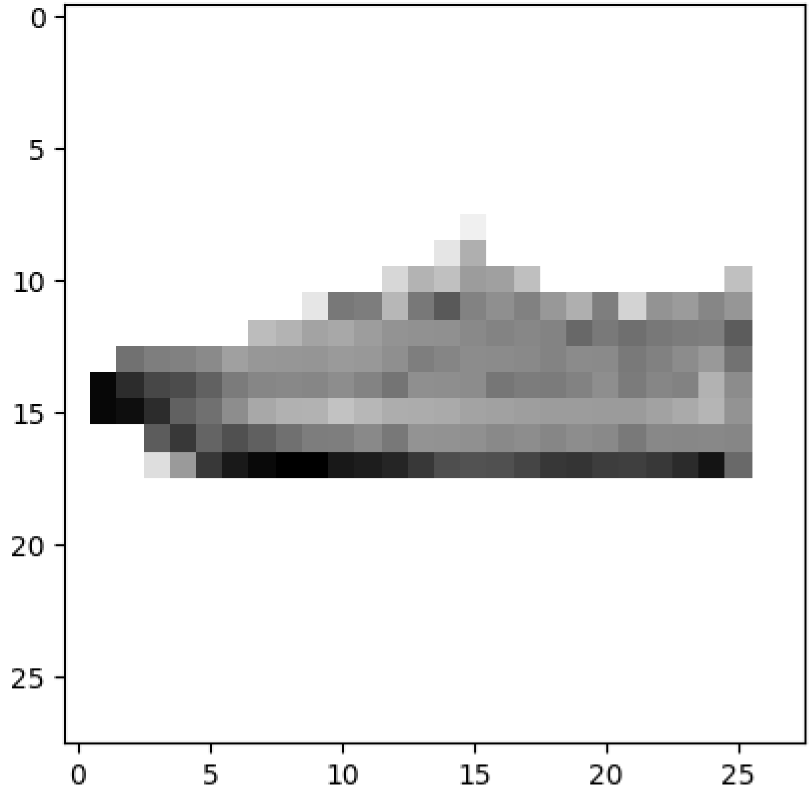
```
predict = 4. coat
wrong
7
1/1 [==============================] - 0s 20ms/step
[[1.6243187e-03 1.0160023e-09 2.9538803e-08 2.1926987e-15 1.7384211e-13
  9.7866231e-01 1.0100812e-07 3.8001972e-06 1.9709544e-02 6.0932209e-10]]
```



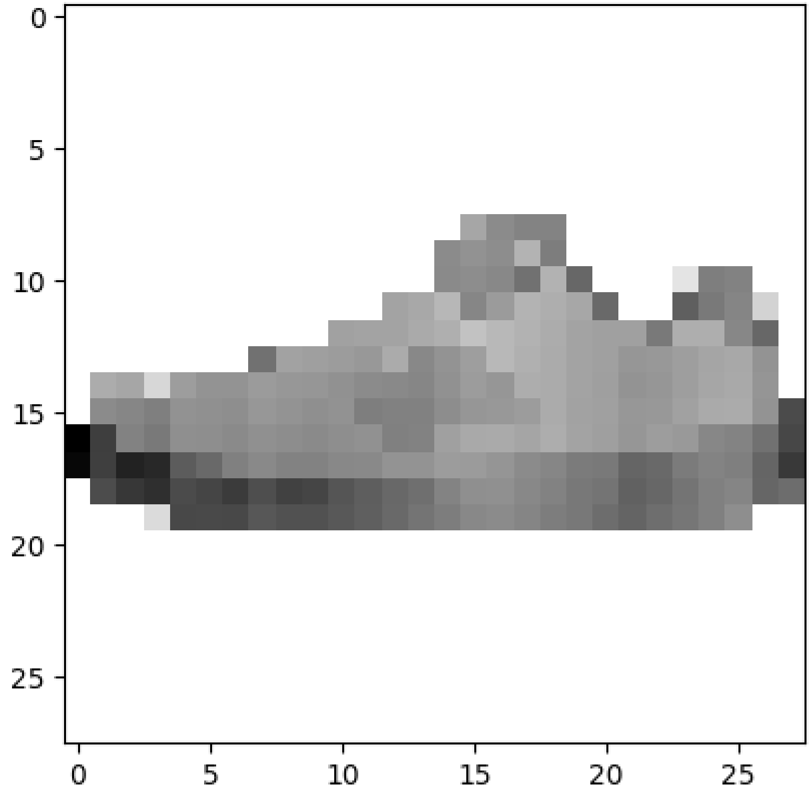
```
predict = 5. sandal
wrong
7
1/1 [==============================] - 0s 22ms/step
[[2.29247454e-11 6.04837903e-13 1.30658635e-11 1.17878297e-14
  4.53978692e-19 1.52043219e-06 1.25173027e-12 9.99893069e-01
  6.04356565e-11 1.05423489e-04]]
```



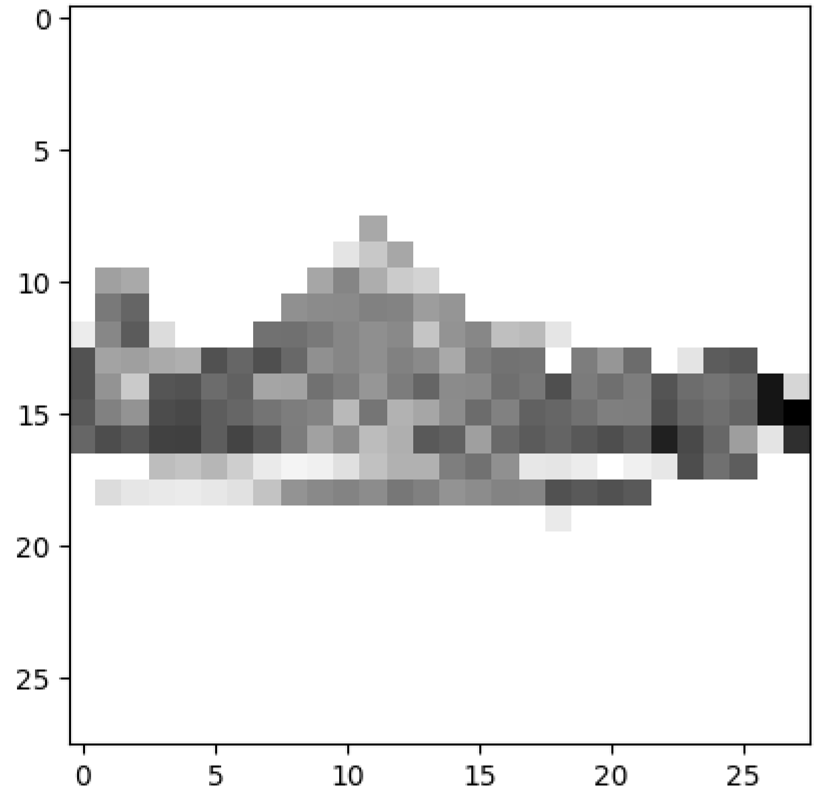
```
predict = 7. sneaker
correct
7
1/1 [==============================] - 0s 22ms/step
[[4.3122919e-09 4.0087295e-11 2.3513842e-11 9.1560230e-14 8.6215712e-18
  6.4916781e-04 1.9167548e-11 9.9803990e-01 5.0714132e-08 1.3109387e-03]]
```



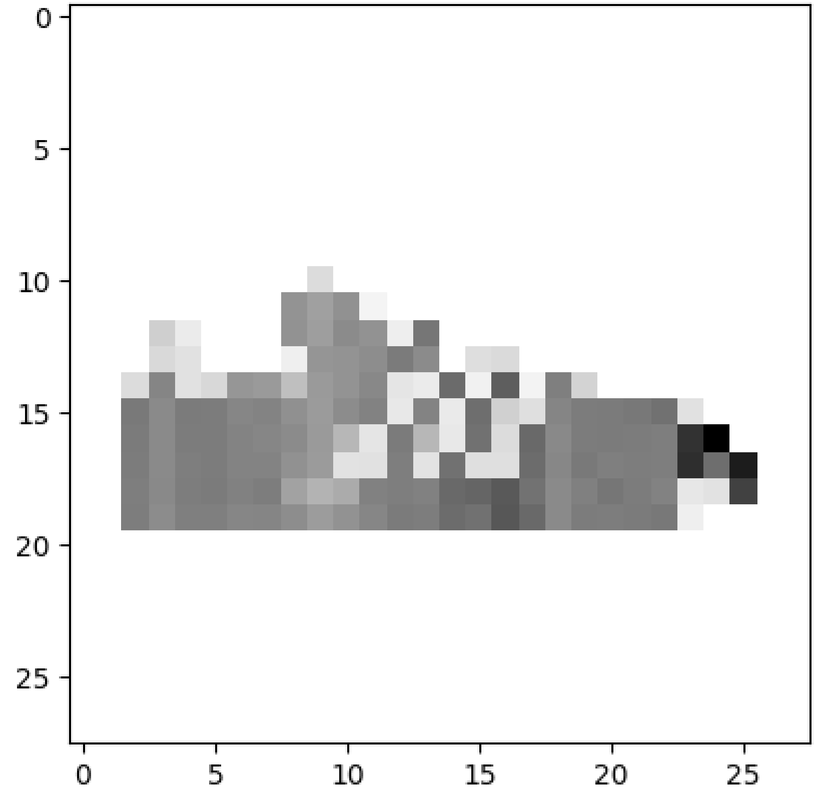
```
predict = 7. sneaker
correct
7
1/1 [==============================] - 0s 19ms/step
[[9.10556526e-12 2.84223301e-13 1.28130145e-11 2.31240027e-12
  3.02631028e-16 7.21114520e-06 2.28722735e-11 9.99770224e-01
  7.75016762e-09 2.22505099e-04]]
```



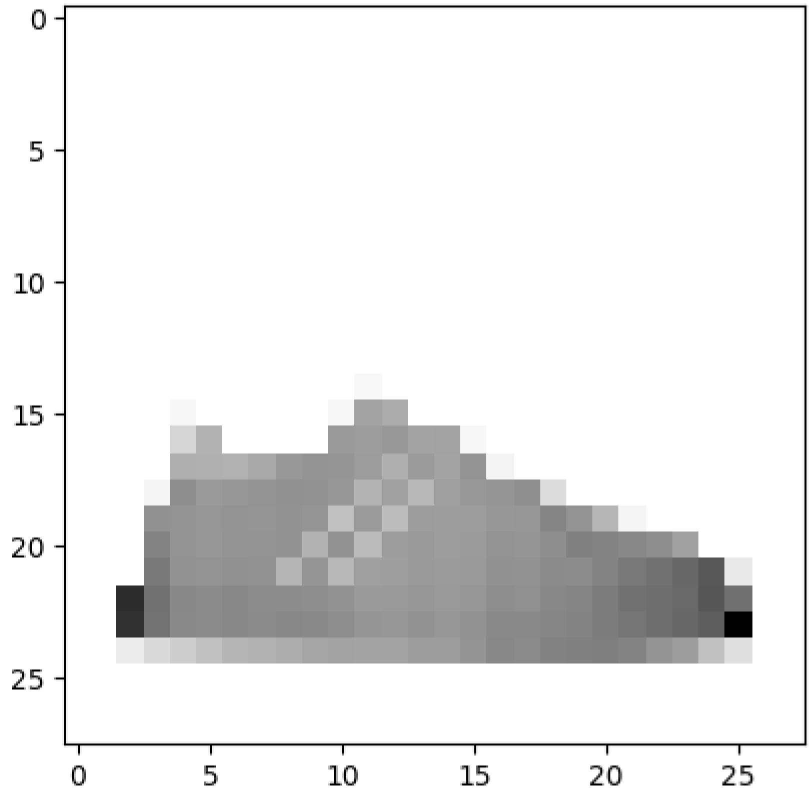
```
predict = 7. sneaker
correct
7
1/1 [==============================] - 0s 22ms/step
[[2.0626462e-10 1.3158989e-12 4.1839887e-10 4.8063577e-16 3.0790331e-16
  9.9999762e-01 1.6705594e-11 2.2574525e-06 9.1908681e-10 1.2492144e-07]]
```



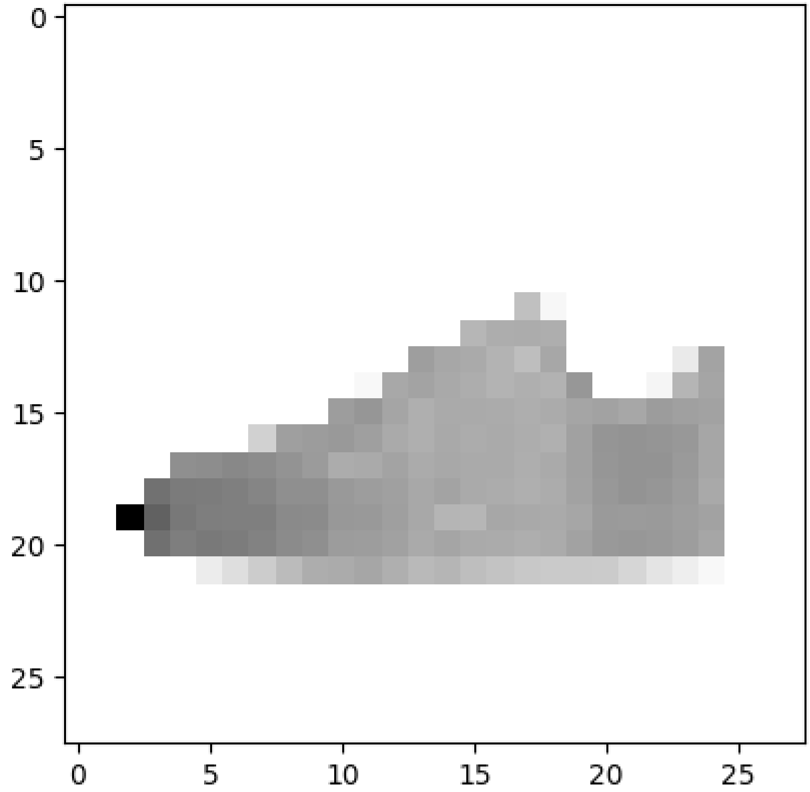
```
predict = 5. sandal
wrong
7
1/1 [==============================] - 0s 21ms/step
[[2.7728815e-13 5.1962780e-13 3.6286370e-14 3.1224707e-18 4.0149005e-19
  1.0000000e+00 1.7292159e-12 1.0102447e-08 2.0008197e-09 6.7178849e-12]]
```



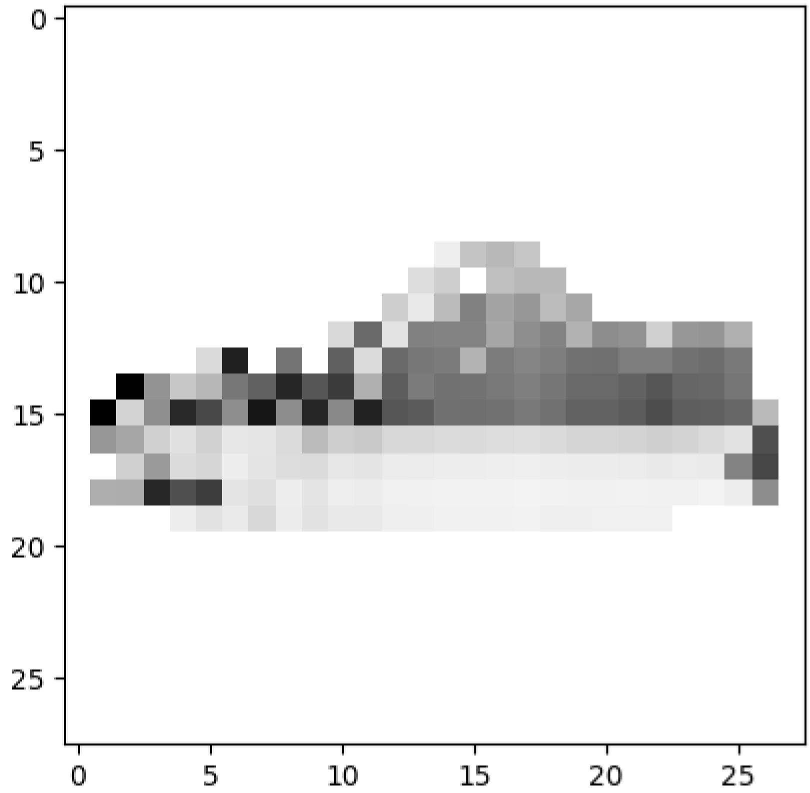
```
predict = 5. sandal
wrong
7
1/1 [==============================] - 0s 20ms/step
[[2.6690563e-07 1.0078226e-08 2.6900386e-09 5.0194372e-05 1.1885058e-06
  2.3343754e-01 1.6744283e-05 2.4440653e-05 7.6646709e-01 2.5844736e-06]]
```



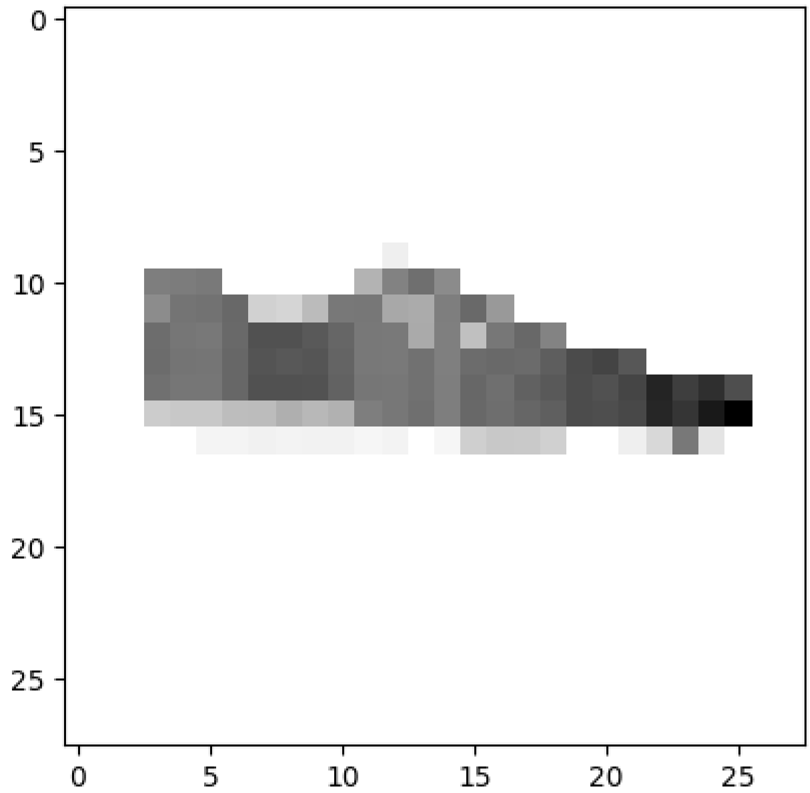
```
predict = 8. bag
wrong
7
1/1 [==============================] - 0s 20ms/step
[[8.8534098e-06 2.2586040e-08 7.2216317e-09 1.0344176e-06 2.4067101e-10
  2.3331277e-02 3.5693683e-06 9.6897113e-01 5.5526686e-03 2.1313806e-03]]
```



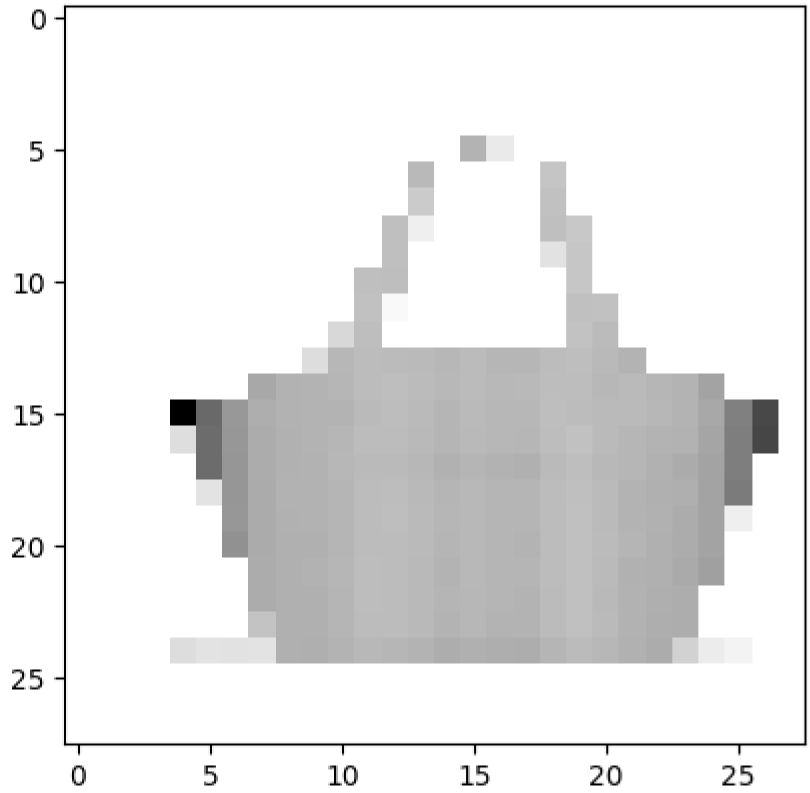
```
predict = 7. sneaker
correct
7
1/1 [==============================] - 0s 21ms/step
[[6.0459562e-09 6.4569856e-13 7.0118299e-12 3.2824926e-13 1.9536283e-16
  5.0825082e-07 2.2548834e-08 9.9999583e-01 2.6751293e-06 1.0151091e-06]]
```



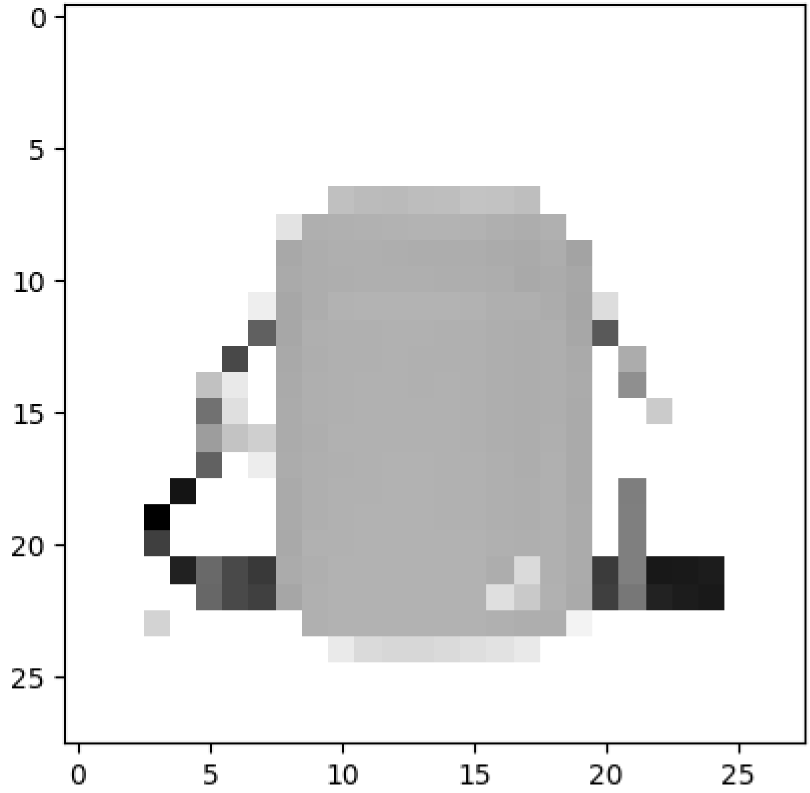
```
predict = 7. sneaker
correct
7
1/1 [==============================] - 0s 22ms/step
[[3.4907428e-06 8.0312027e-13 3.3466380e-10 5.7660711e-14 7.6406653e-19
  1.2795730e-01 1.7411594e-06 8.7198699e-01 4.6268142e-05 4.1440076e-06]]
```



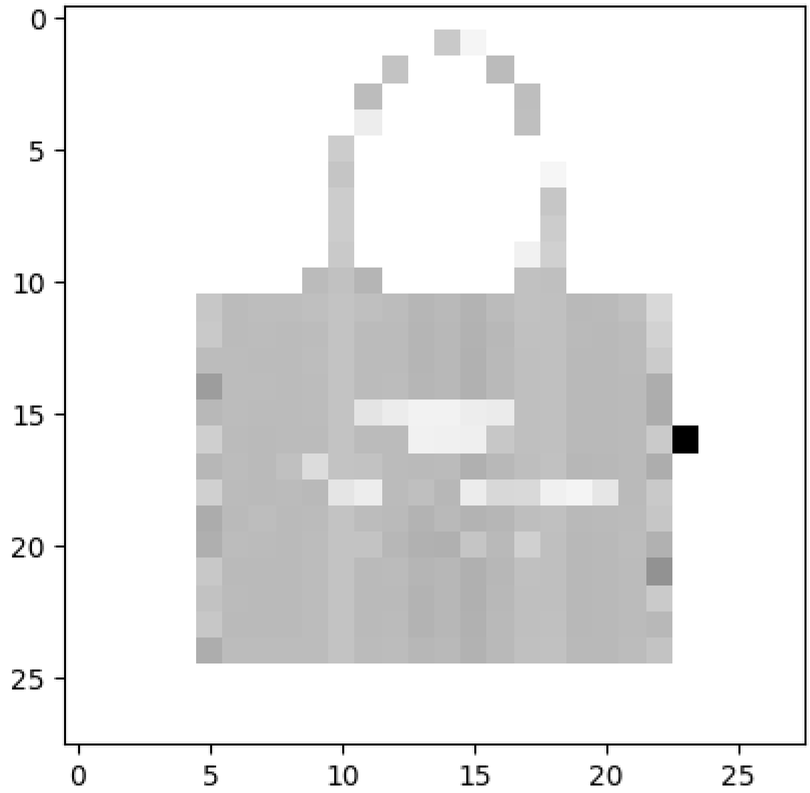
```
predict = 7. sneaker
correct
8
1/1 [==============================] - 0s 21ms/step
[[1.0234104e-14 6.4627099e-19 9.7927451e-17 1.0028623e-13 4.3430399e-15
  2.4984070e-11 2.4844100e-13 3.0354431e-11 1.0000000e+00 9.2746372e-15]]
```



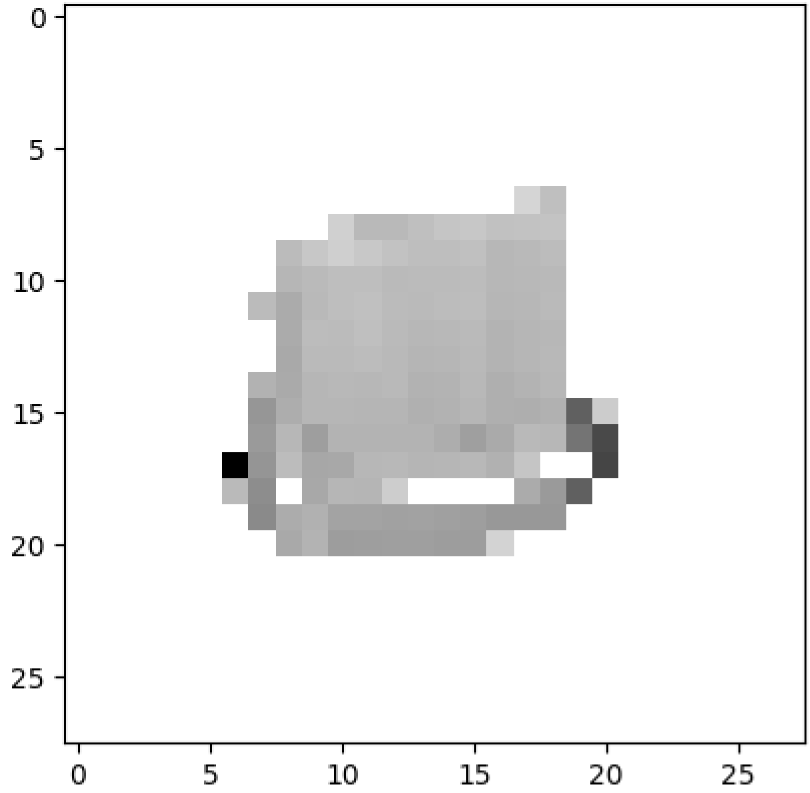
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 21ms/step
[[1.8586044e-05 1.5497972e-09 1.9323487e-08 1.8234694e-07 7.6839549e-11
  4.4040120e-05 5.7985721e-07 1.5432077e-07 9.9992681e-01 9.6388103e-06]]
```



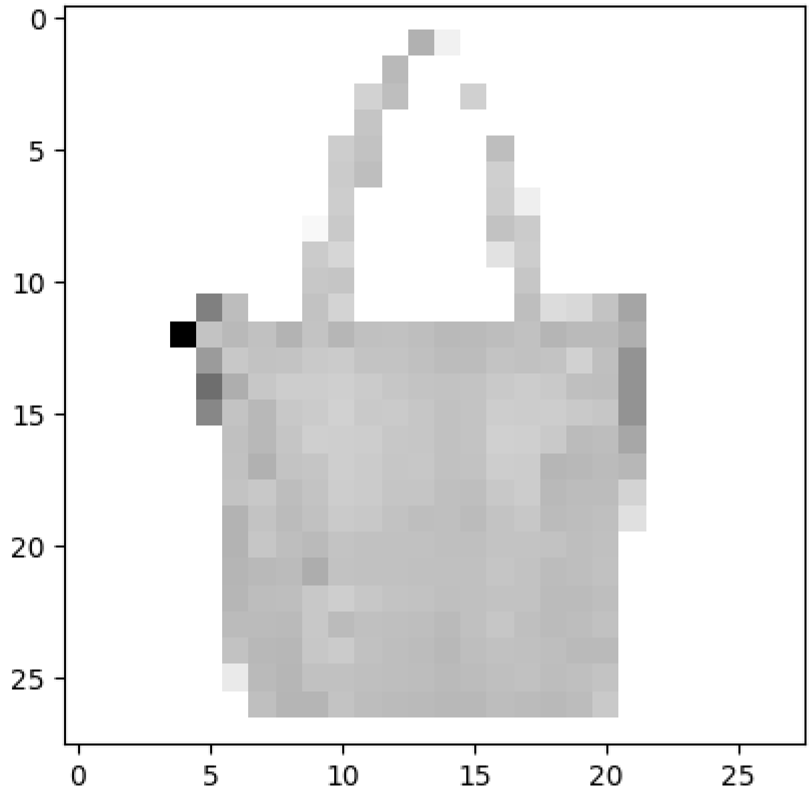
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 20ms/step
[[1.8706449e-12 3.1622450e-17 2.6227424e-18 4.2754645e-14 3.9337404e-15
  5.5930187e-12 1.0869432e-13 1.2017511e-13 1.0000000e+00 2.3388390e-16]]
```



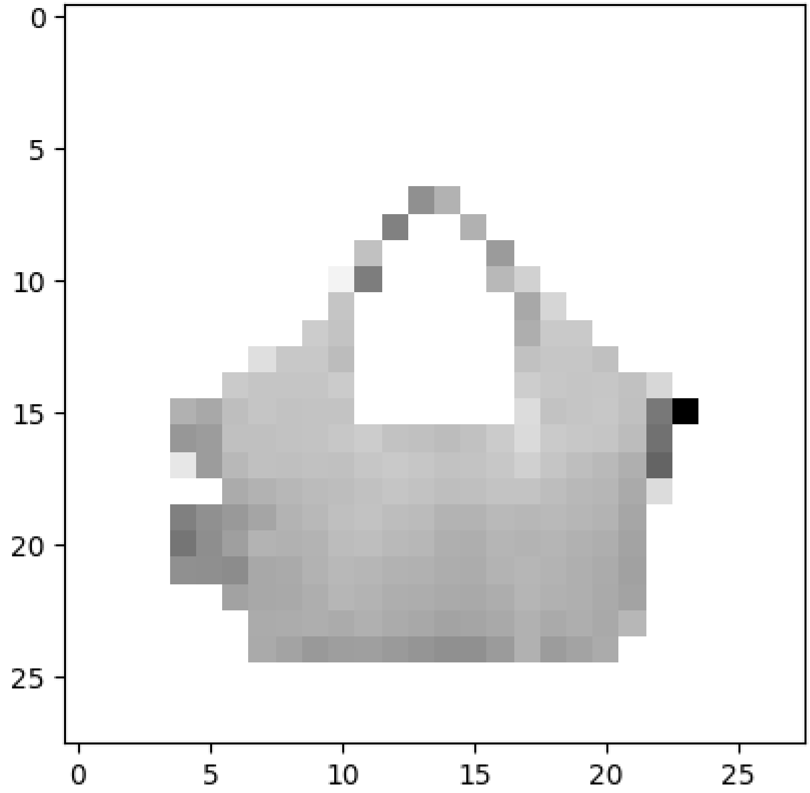
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 24ms/step
[[3.6782552e-05 7.1510326e-06 2.4806341e-04 9.4314944e-04 9.0753369e-05
  9.9682307e-01 6.6758401e-04 7.5202570e-06 1.6076019e-05 1.1598885e-03]]
```



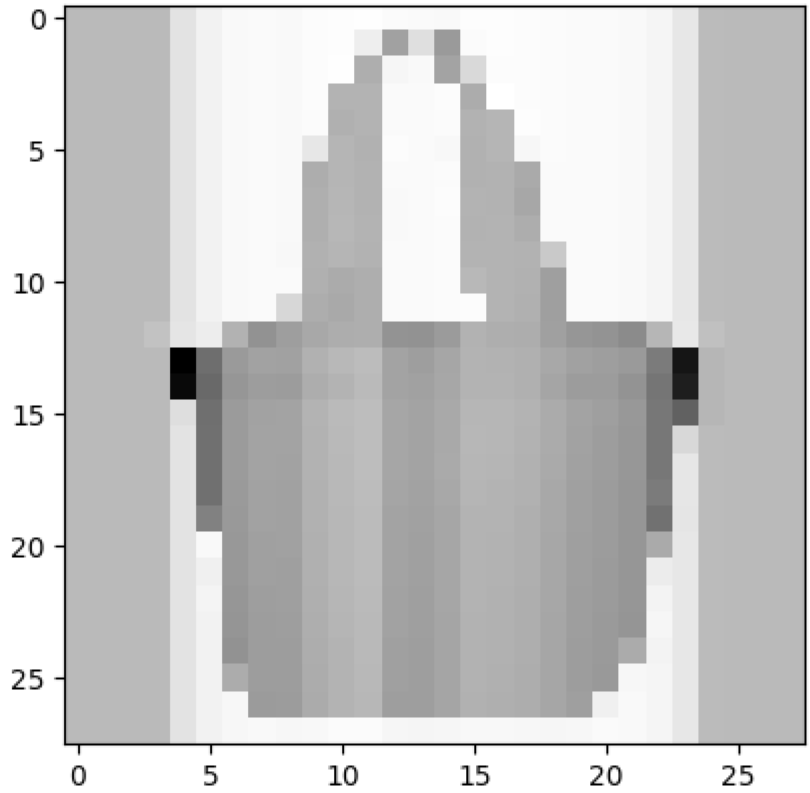
```
predict = 5. sandal
wrong
8
1/1 [==============================] - 0s 27ms/step
[[1.0486892e-18 2.8185868e-23 1.8434685e-22 4.2705454e-20 2.8263351e-18
  9.7407900e-21 9.9076079e-18 1.5031459e-19 1.0000000e+00 1.0426598e-22]]
```



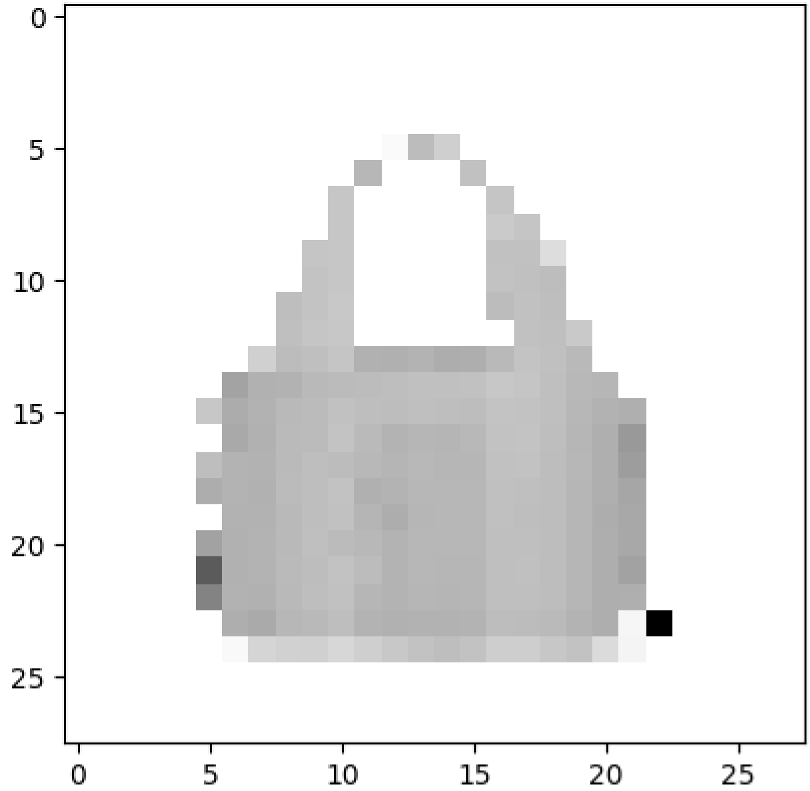
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 23ms/step
[[2.4503975e-14 2.4537792e-14 1.8531319e-14 1.4860670e-12 6.6865201e-14
  5.4650929e-08 3.2000764e-13 3.6983745e-12 1.0000000e+00 9.6913757e-15]]
```



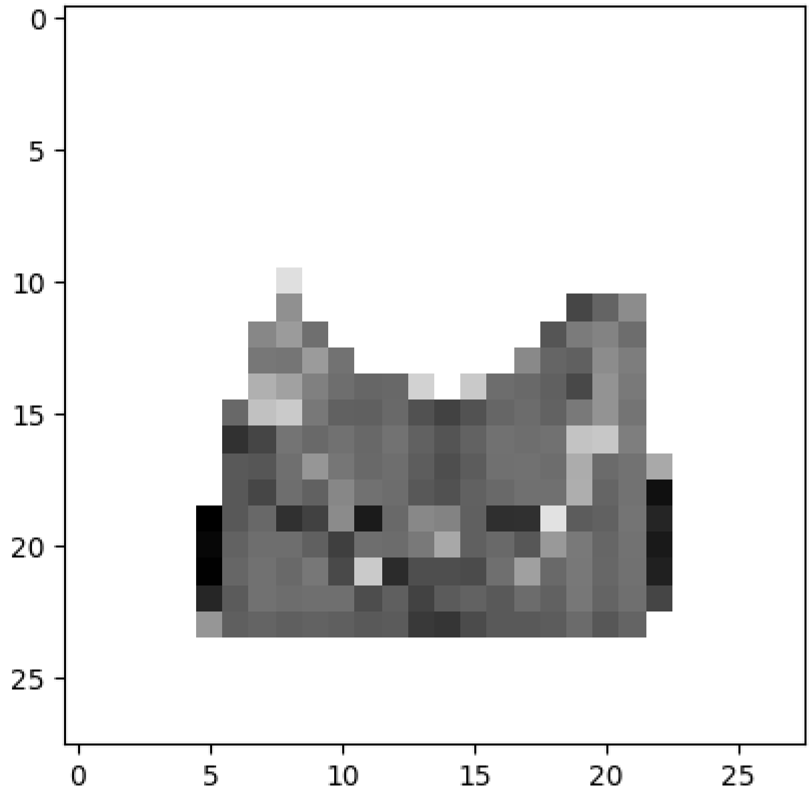
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 21ms/step
[[7.2733813e-10 7.2117984e-14 1.0867757e-09 1.1097804e-08 3.0229889e-06
  7.3967322e-14 5.7808597e-07 1.8089795e-10 9.9999642e-01 3.6505360e-12]]
```



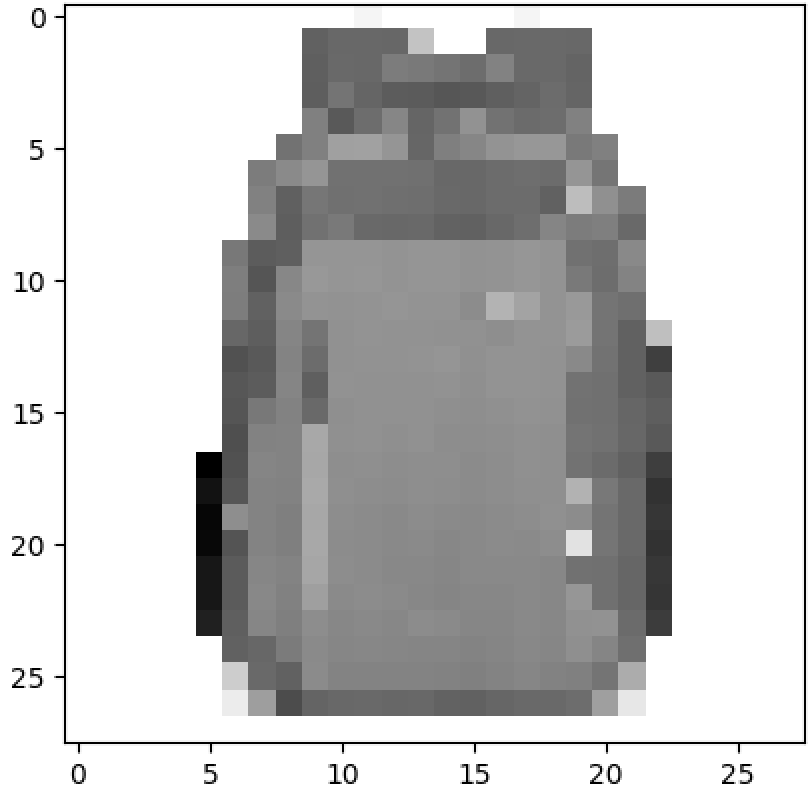
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 22ms/step
[[1.4247432e-13 1.1071266e-16 1.6354728e-15 9.9942087e-15 1.7120348e-13
  1.4188395e-13 2.7406235e-13 2.1507890e-15 1.0000000e+00 1.6129564e-16]]
```



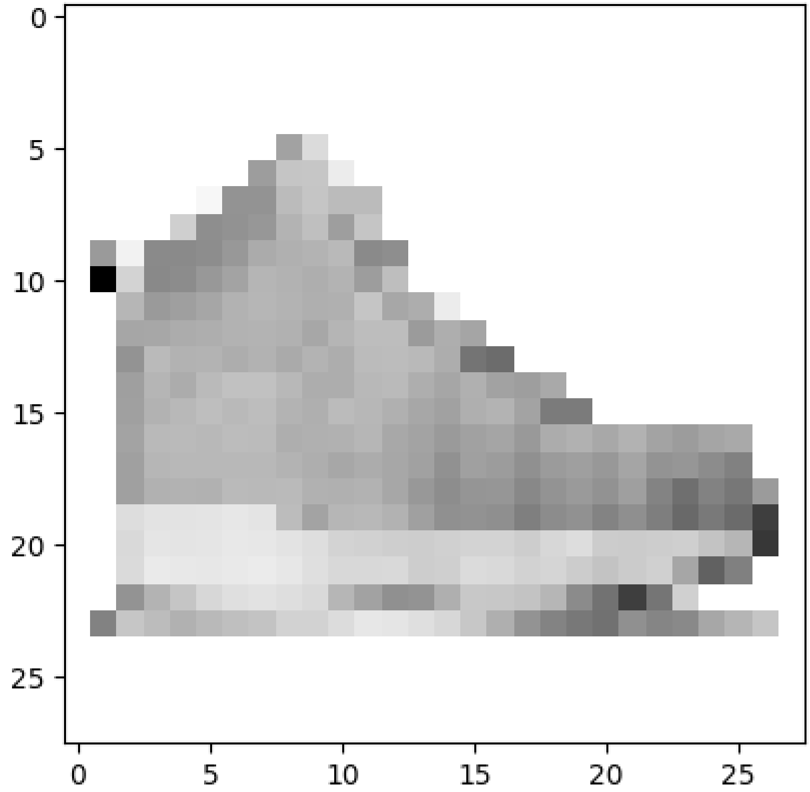
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 22ms/step
[[8.85598456e-06 2.32060202e-08 5.29927602e-10 7.97638122e-10
  3.38926692e-10 6.07859604e-02 3.54927153e-07 1.04814116e-10
  9.39204752e-01 1.24609517e-10]]
```



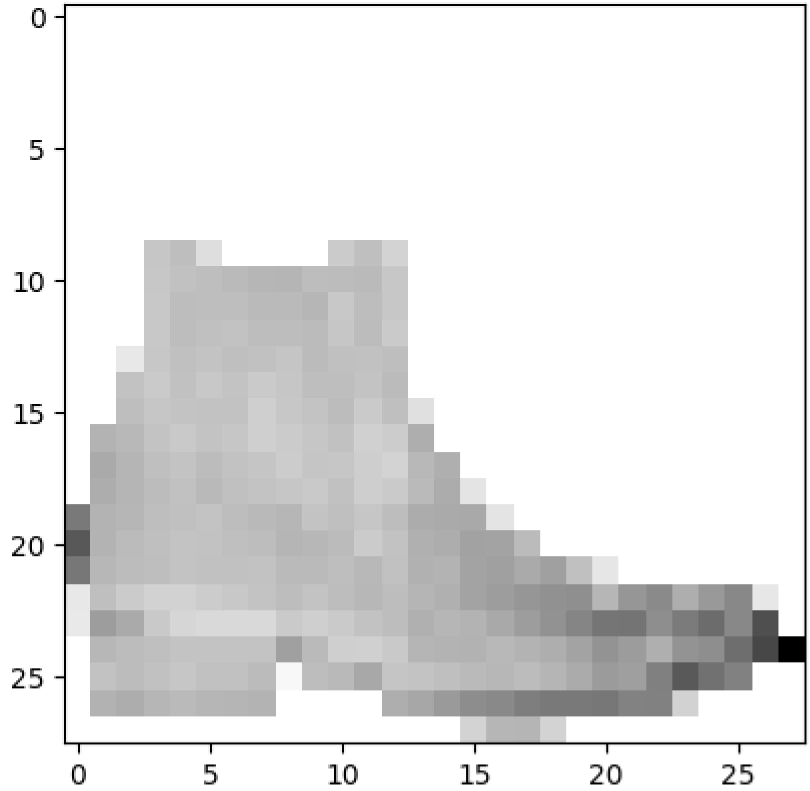
```
predict = 8. bag
correct
8
1/1 [==============================] - 0s 24ms/step
[[1.1460714e-01 9.2169503e-06 5.8105033e-02 2.1009748e-01 5.8050889e-01
  7.3515014e-07 3.4871414e-02 1.6048891e-03 1.6907704e-04 2.6042058e-05]]
```



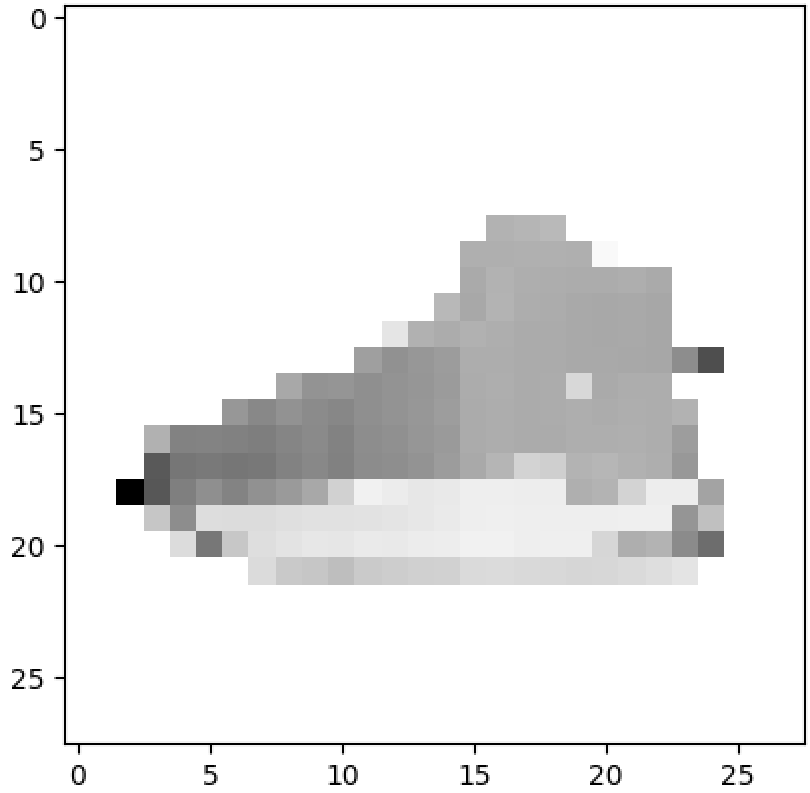
```
predict = 4. coat
wrong
9
1/1 [==============================] - 0s 22ms/step
[[9.2303075e-05 1.3364601e-06 9.9575740e-01 9.7367758e-10 1.3827851e-05
  3.6689762e-03 4.3071251e-04 3.8895138e-07 3.3490523e-05 1.5818046e-06]]
```



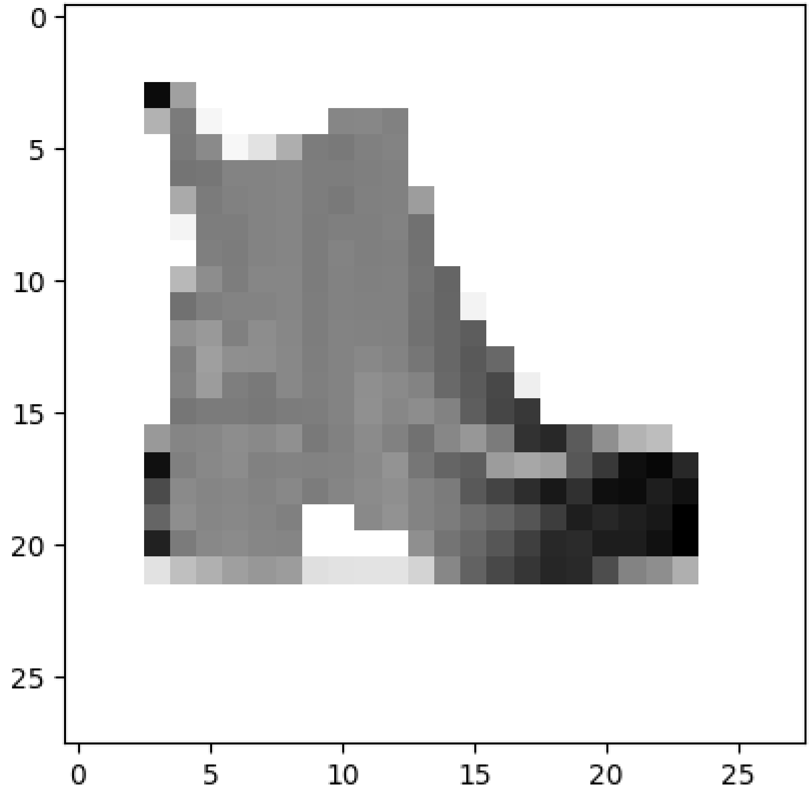
```
predict = 2. pullover
wrong
9
1/1 [==============================] - 0s 22ms/step
[[6.9149202e-01 2.0087084e-06 2.5725514e-01 3.0323074e-06 5.9377843e-08
  4.9666286e-02 1.1288916e-03 1.4379433e-06 4.5097779e-04 1.8785202e-07]]
```



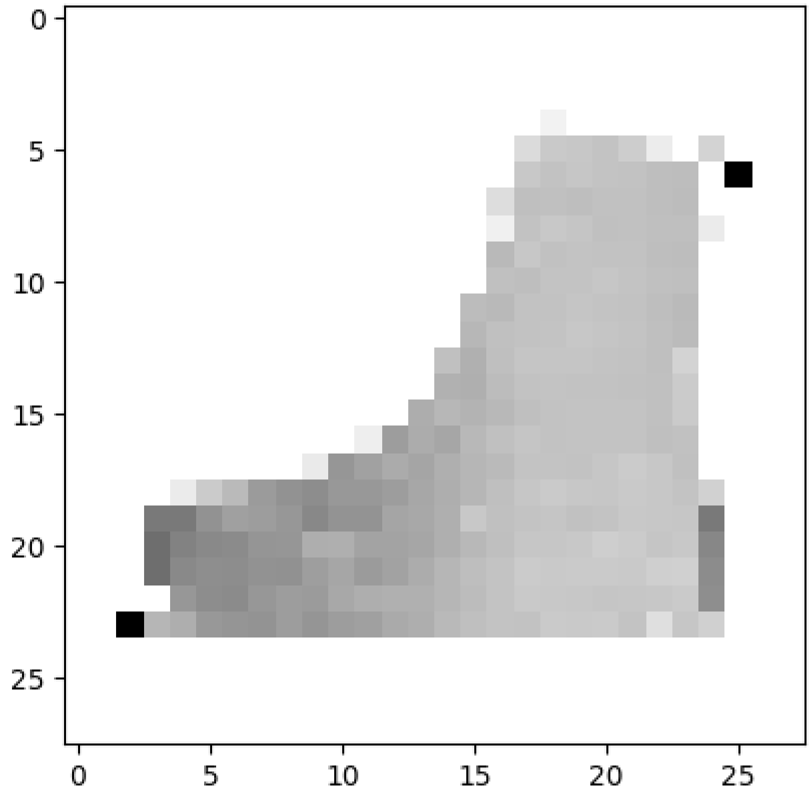
```
predict = 0. T-shirt_top
wrong
9
1/1 [==============================] - 0s 29ms/step
[[8.2137276e-11 2.1251989e-10 7.6064499e-10 1.3520345e-09 1.4840996e-11
  1.0125249e-05 5.7989019e-10 9.9966669e-01 4.0667206e-10 3.2319524e-04]]
```



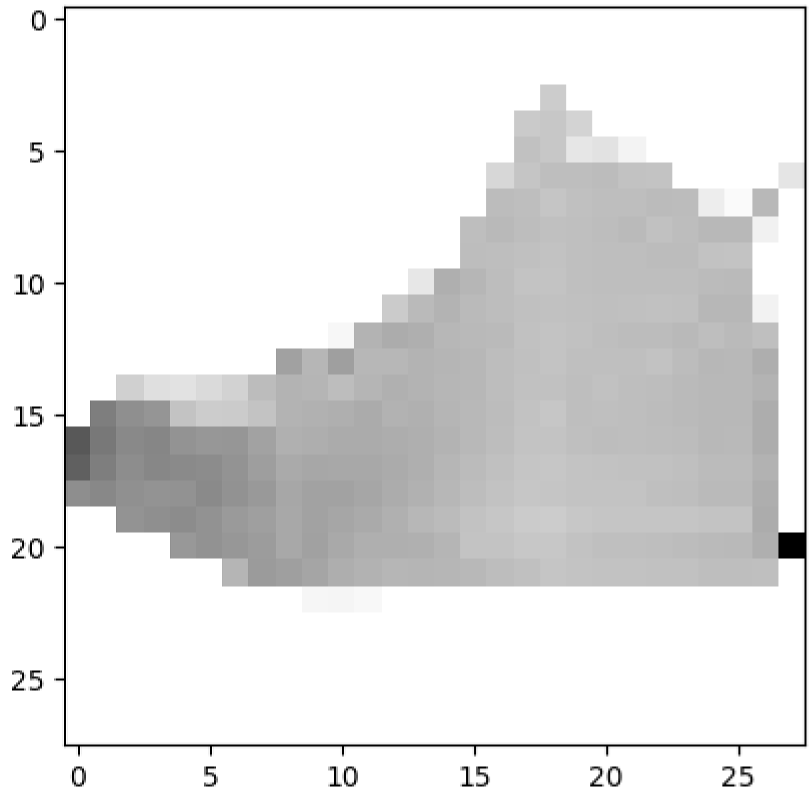
```
predict = 7. sneaker
wrong
9
1/1 [==============================] - 0s 25ms/step
[[3.9915558e-05 1.7371184e-04 1.3552621e-01 7.7577839e-03 3.0454175e-05
  3.0305460e-05 9.9267010e-03 2.6497932e-07 8.4650952e-01 5.1960974e-06]]
```



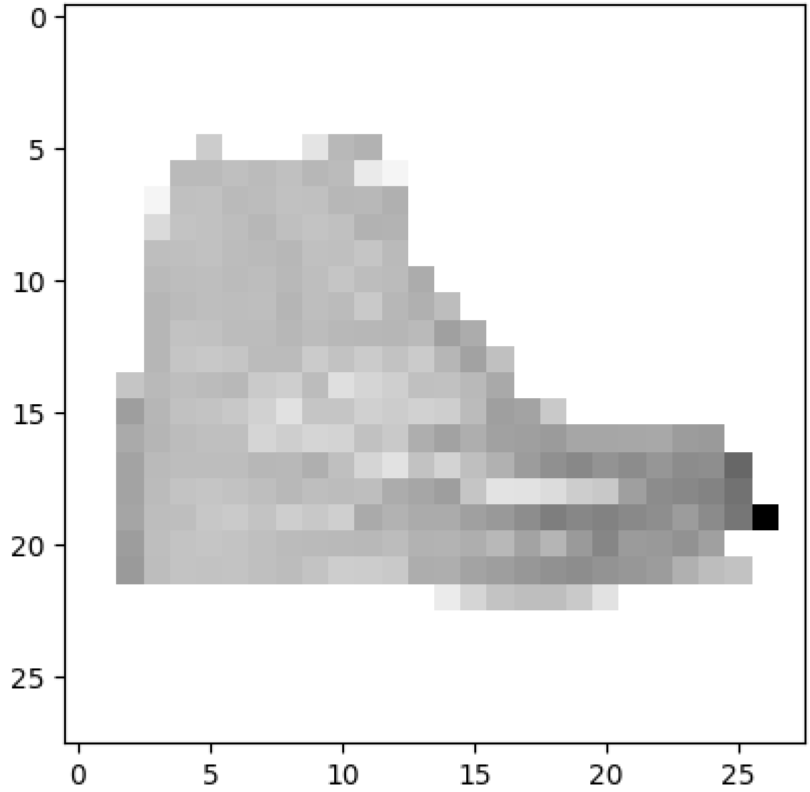
```
predict = 8. bag
wrong
9
1/1 [==============================] - 0s 20ms/step
[[6.8123500e-06 1.9847919e-08 1.4829077e-11 4.2572779e-10 1.9144159e-14
  2.8485703e-01 5.8362218e-08 3.5673935e-02 2.6814517e-08 6.7946219e-01]]
```



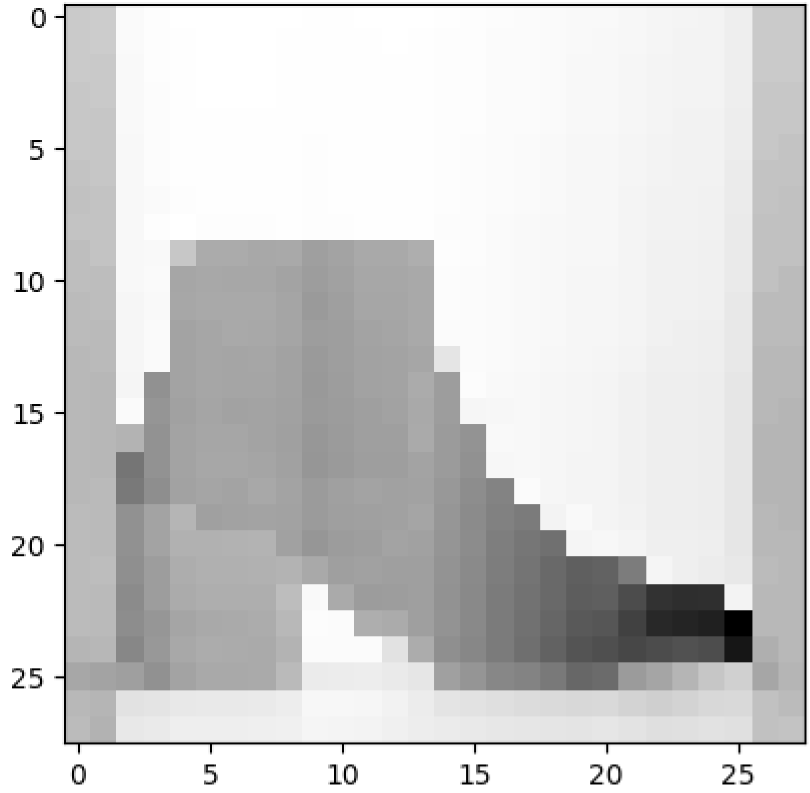
```
predict = 9. ankle boot
correct
9
1/1 [==============================] - 0s 23ms/step
[[1.9684243e-10 7.4654519e-12 4.6884869e-09 2.7902116e-11 3.0322969e-10
  2.5595157e-10 1.1159240e-10 3.3745944e-02 3.6572138e-11 9.6625406e-01]]
```



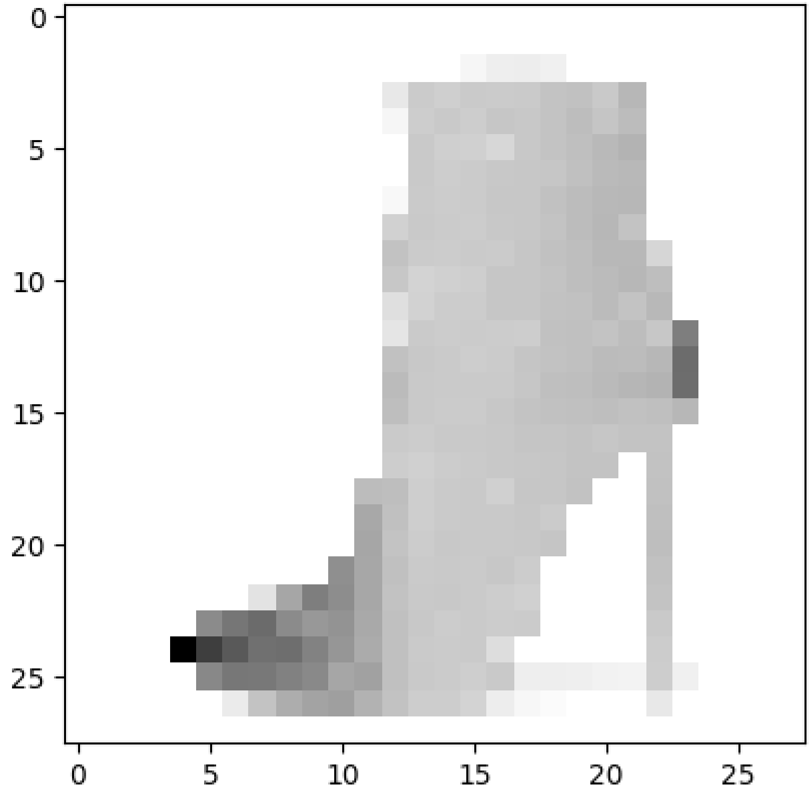
```
predict = 9. ankle boot
correct
9
1/1 [==============================] - 0s 21ms/step
[[2.7809056e-02 4.2168204e-02 7.8100055e-01 3.1653464e-05 9.7272471e-03
  1.1952082e-01 1.9241836e-02 1.7607821e-06 4.3093279e-04 6.8017376e-05]]
```



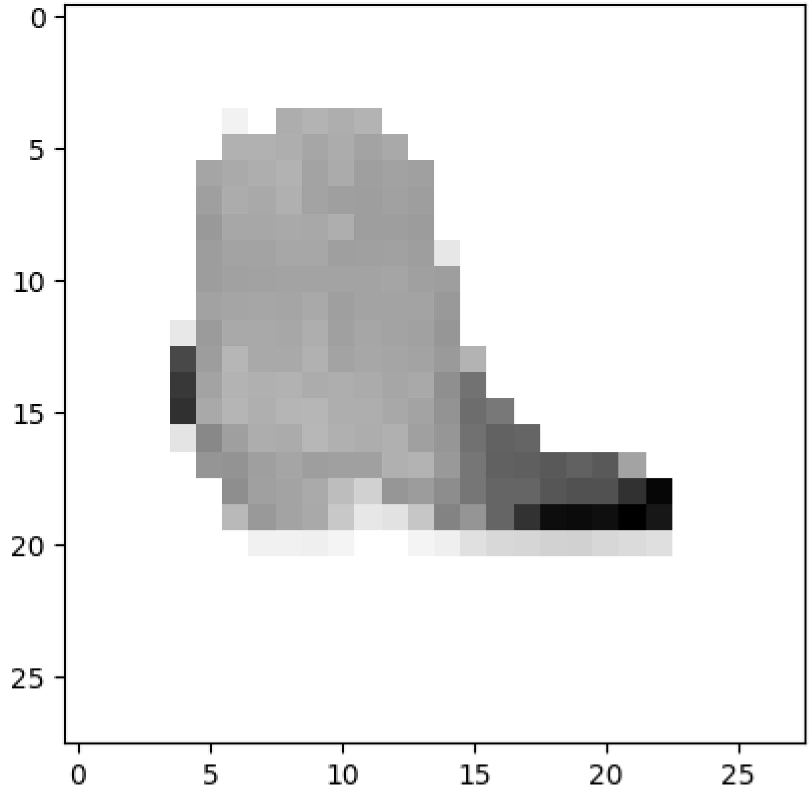
```
predict = 2. pullover
wrong
9
1/1 [==============================] - 0s 21ms/step
[[2.3021627e-02 2.2729646e-05 2.0960750e-02 1.8252157e-08 3.2953751e-05
  8.0988538e-01 5.6730519e-04 1.4704319e-05 1.4548500e-01 9.5939859e-06]]
```



```
predict = 5. sandal
wrong
9
1/1 [==============================] - 0s 22ms/step
[[1.0821652e-08 5.9611379e-05 1.1902647e-10 7.3517117e-07 3.0706246e-08
  7.8837704e-03 4.7355173e-09 4.5775619e-06 1.7242396e-08 9.9205130e-01]]
```



```
predict = 9. ankle boot
correct
9
1/1 [==============================] - 0s 20ms/step
[[1.7139764e-05 2.7053374e-01 2.1179968e-03 6.4344072e-01 9.8428631e-05
  1.1199300e-02 4.6105105e-02 1.0462245e-06 2.6413482e-02 7.2960691e-05]]
```



```
predict = 3. dress
wrong
total = 100
acc = 57.99999999999999 %
```

In this cell we iterate trough all the pictures and run them trough the model seperately. We also check if the guess was correct and calculated the accuracy of the model.

Additional Questions

- In which way could the network accuracy be improved further (only explanation, no implementation)?

the model accuracy is pretty low at 58%, this is because certain classes are very hard to distinguish. mainly coat, pullover and shirt are very similar. the accuracy could be increased by providing images with more detail or color.