In [1]:

```
import tensorflow as tf
import matplotlib.pyplot as plt
from tensorflow import keras
import numpy as np
```

In [2]:

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

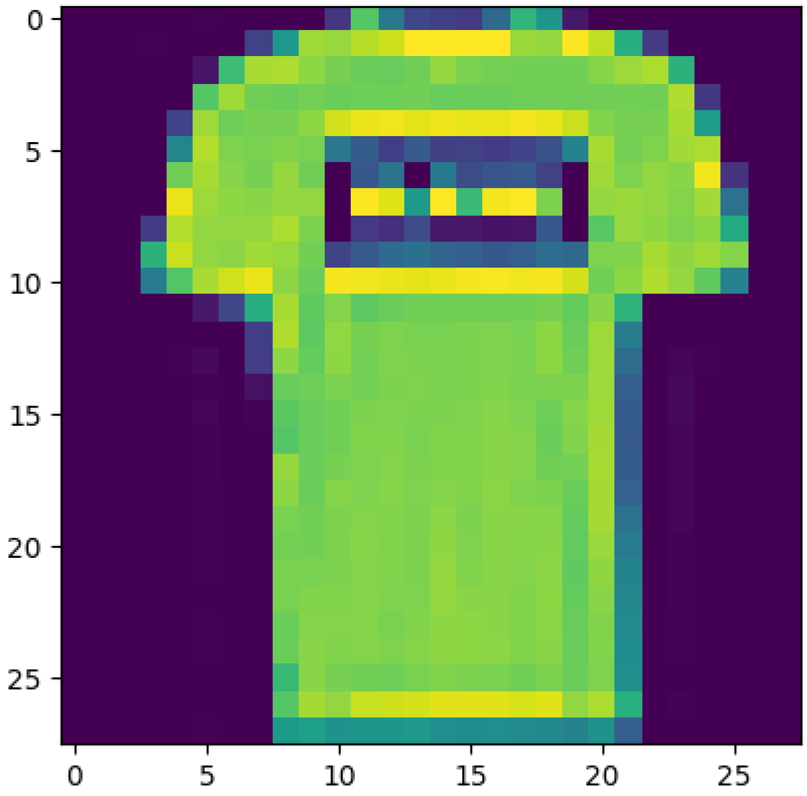
```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/tra
in-labels-idx1-ubyte.gz
29515/29515 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/tra
in-images-idx3-ubyte.gz
26421880/26421880 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10
k-labels-idx1-ubyte.gz
5148/5148 [==============================] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10
k-images-idx3-ubyte.gz
4422102/4422102 [==============================] - 0s 0us/step
```

In [4]:

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

Out[4]:

```
<matplotlib.image.AxesImage at 0x7f134effcf40>
```

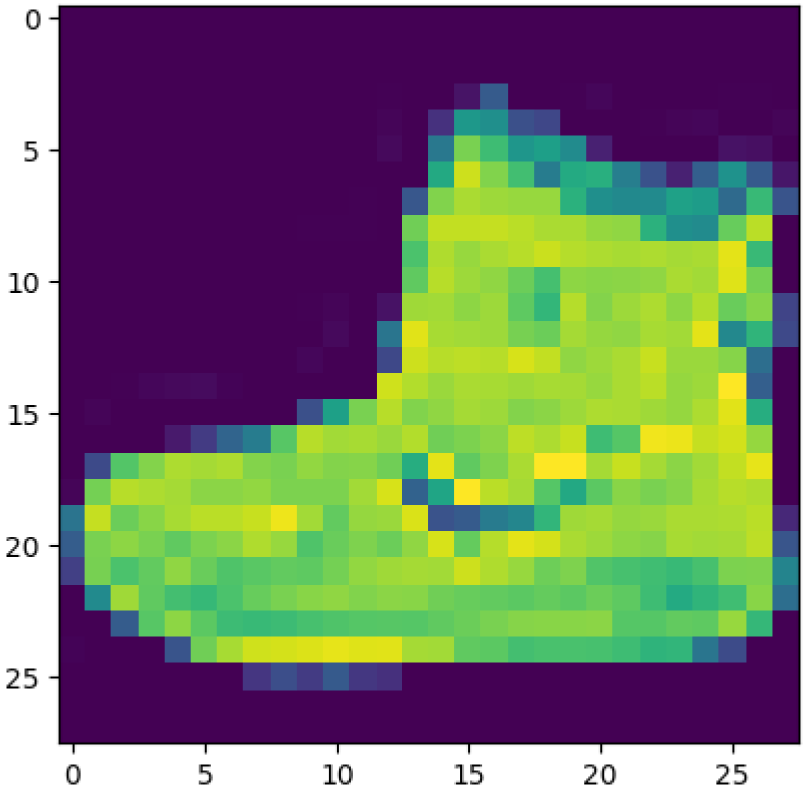


In [5]:

```
plt.imshow(x_train[0])
```

Out[5]:

```
<matplotlib.image.AxesImage at 0x7f13492692e0>
```



In [6]:

```
x_train = x_train.astype('float32') / 255.0
x_test = x_test.astype('float32') / 255.0
x_train = x_train.reshape(-1, 28, 28, 1)
x_test = x_test.reshape(-1, 28, 28, 1)
```

In [8]:

```
x_train.shape
```

Out[8]:

```
(60000, 28, 28, 1)
```

In [9]:

```
x_test.shape
```

Out[9]:

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

In [10]:

```
y_train.shape
```

Out[10]:

```
(60000,)
```

In [11]:

```
y_test.shape
```

Out[11]:

```
(10000,)
```

In [12]:

```
model = keras.Sequential([
keras.layers.Conv2D(32, (3,3), activation='relu', input_shape=(28,28,1)),
keras.layers.MaxPooling2D((2,2)),
keras.layers.Dropout(0.25),
keras.layers.Conv2D(64, (3,3), activation='relu'),
keras.layers.MaxPooling2D((2,2)),
keras.layers.Dropout(0.25),
keras.layers.Conv2D(128, (3,3), activation='relu'),
keras.layers.Flatten(),
keras.layers.Dense(128, activation='relu'),
keras.layers.Dropout(0.25),
keras.layers.Dense(10, activation='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
 )

 dropout (Dropout)           (None, 13, 13, 32)        0

 conv2d_1 (Conv2D)           (None, 11, 11, 64)        18496

 max_pooling2d_1 (MaxPooling  (None, 5, 5, 64)         0
 2D)

 dropout_1 (Dropout)         (None, 5, 5, 64)          0

 conv2d_2 (Conv2D)           (None, 3, 3, 128)         73856

 flatten (Flatten)           (None, 1152)              0

 dense (Dense)               (None, 128)               147584

 dropout_2 (Dropout)         (None, 128)               0

 dense_1 (Dense)             (None, 10)                1290

=================================================================
Total params: 241,546
Trainable params: 241,546
Non-trainable params: 0
_________________________________________________________________
```

In [13]:

```
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accu
history = model.fit(x_train, y_train, epochs=10, validation_data=(x_test, y_test))
```

```
Epoch 1/10
1875/1875 [==============================] - 79s 41ms/step - loss: 0.5641 - accuracy:
0.7937 - val_loss: 0.3837 - val_accuracy: 0.8573
Epoch 2/10
1875/1875 [==============================] - 76s 41ms/step - loss: 0.3717 - accuracy:
0.8630 - val_loss: 0.3210 - val_accuracy: 0.8839
Epoch 3/10
1875/1875 [==============================] - 78s 42ms/step - loss: 0.3274 - accuracy:
0.8800 - val_loss: 0.2994 - val_accuracy: 0.8894
Epoch 4/10
1875/1875 [==============================] - 75s 40ms/step - loss: 0.3020 - accuracy:
0.8880 - val_loss: 0.3065 - val_accuracy: 0.8839
Epoch 5/10
1875/1875 [==============================] - 78s 42ms/step - loss: 0.2834 - accuracy:
0.8956 - val_loss: 0.2740 - val_accuracy: 0.8997
Epoch 6/10
1875/1875 [==============================] - 76s 41ms/step - loss: 0.2694 - accuracy:
0.8994 - val_loss: 0.2656 - val_accuracy: 0.8984
Epoch 7/10
1875/1875 [==============================] - 77s 41ms/step - loss: 0.2597 - accuracy:
0.9026 - val_loss: 0.2845 - val_accuracy: 0.9002
Epoch 8/10
1875/1875 [==============================] - 77s 41ms/step - loss: 0.2511 - accuracy:
0.9066 - val_loss: 0.2661 - val_accuracy: 0.9016
Epoch 9/10
1875/1875 [==============================] - 77s 41ms/step - loss: 0.2393 - accuracy:
0.9097 - val_loss: 0.2755 - val_accuracy: 0.9022
Epoch 10/10
1875/1875 [==============================] - 76s 40ms/step - loss: 0.2352 - accuracy:
0.9108 - val_loss: 0.2523 - val_accuracy: 0.9066
```

In [15]:

```
test_loss, test_acc = model.evaluate(x_test, y_test)
```

```
313/313 [==============================] - 4s 13ms/step - loss: 0.2523 - accuracy: 0.
9066
```

In [16]:

```
print('Test accuracy:', test_acc)
```

```
Test accuracy: 0.9065999984741211
```