

```
469/469 [=====] - 81s 173ms/step - loss: 0.1285 - accuracy: 0.9528 - val_loss: 0.2297 - val_accuracy: 0.92
313/313 [=====] - 5s 17ms/step - loss: 0.2297 - accuracy: 0.9217
Test accuracy: 0.9217000007629395
```

```
!pip install mkl
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: mkl in /usr/local/lib/python3.10/dist-packages (2019.0)
Requirement already satisfied: intel-openmp in /usr/local/lib/python3.10/dist-packages (from mkl) (2023.1.0)
```

```
!pip install tensorflow
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.12.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (23.3.3)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.0)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.54.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.8.0)
Requirement already satisfied: jax>=0.3.15 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.10)
Requirement already satisfied: keras<2.13,>=2.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.0)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (16.0.0)
Requirement already satisfied: numpy<1.24,>=1.22 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.22.4)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow) (23.1)
Requirement already satisfied: protobuf!=4.21.0,!>4.21.1,!>4.21.2,!>4.21.3,!>4.21.4,!>4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: tensorboard<2.13,>=2.12 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.2)
Requirement already satisfied: tensorflow-estimator<2.13,>=2.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.1
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.3.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.5.0)
Requirement already satisfied: wheel<1.15,>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.14.1)
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Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.0)
Requirement already satisfied: astunparse>=1.6.0->tensorflow) (1.6.3)
Requirement already satisfied: mkl-ctypes>=0.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.1.0)
Requirement already satisfied: scipy>=1.7 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.10.1)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.5.1)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.6.8)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.21.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.7.0)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.0)
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.0.1)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.2.1)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.1)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.7.1)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.3.1)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.26.15)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2023.7.22)
Requirement already satisfied: charset-normalizer>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.4)
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.1.1)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.2.2)
```

```
import os
os.environ['MKL_THREADING_LAYER'] = 'GNU'
import tensorflow as tf
print(tf.config.threading.get_intra_op_parallelism_threads())
```

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```
#importing the required libraries
from tensorflow.keras.datasets import fashion_mnist
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D
from tensorflow.keras.layers import MaxPool2D
from tensorflow.keras.layers import Flatten
from tensorflow.keras.layers import Dropout
from tensorflow.keras.layers import Dense
#loading data
(X_train,y_train) , (X_test,y_test)=fashion_mnist.load_data()
#reshaping data
X_train = X_train.reshape((X_train.shape[0], X_train.shape[1], X_train.shape[2], 1))
X_test = X_test.reshape((X_test.shape[0],X_test.shape[1],X_test.shape[2],1))
#checking the shape after reshaping
print(X_train.shape)
print(X_test.shape)
#normalizing the pixel values
```

```

X_train=X_train/255
X_test=X_test/255
#defining model
model=Sequential()
#adding convolution layer
model.add(Conv2D(32,(3,3),activation='relu',input_shape=(28,28,1)))
#adding pooling layer
model.add(MaxPool2D(2,2))

(60000, 28, 28, 1)
(10000, 28, 28, 1)

#adding fully connected layer
model.add(Flatten())
model.add(Dense(100,activation='relu'))
#adding output layer
model.add(Dense(10,activation='softmax'))
#compiling the model
model.compile(loss='sparse_categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
#fitting the model
model.fit(X_train,y_train,epochs=10)

Epoch 1/10
1875/1875 [=====] - 48s 25ms/step - loss: 0.3974 - accuracy: 0.8589
Epoch 2/10
1875/1875 [=====] - 45s 24ms/step - loss: 0.2699 - accuracy: 0.9021
Epoch 3/10
1875/1875 [=====] - 45s 24ms/step - loss: 0.2256 - accuracy: 0.9162
Epoch 4/10
1875/1875 [=====] - 45s 24ms/step - loss: 0.1950 - accuracy: 0.9280
Epoch 5/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.1679 - accuracy: 0.9380
Epoch 6/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.1456 - accuracy: 0.9456
Epoch 7/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.1256 - accuracy: 0.9535
Epoch 8/10
1875/1875 [=====] - 45s 24ms/step - loss: 0.1084 - accuracy: 0.9600
Epoch 9/10
1875/1875 [=====] - 44s 23ms/step - loss: 0.0959 - accuracy: 0.9648
Epoch 10/10
1875/1875 [=====] - 46s 25ms/step - loss: 0.0808 - accuracy: 0.9708
<keras.callbacks.History at 0x7f5cdaa2b490>

model.evaluate(X_test,y_test)

313/313 [=====] - 3s 10ms/step - loss: 0.3023 - accuracy: 0.9093
[0.3022787272930145, 0.9093000292778015]

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