Build CNN priject

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import keras

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

```
X_test.shape ,y_test.shape
```

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

```
X_train.shape , y_train.shape
```

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

```
X_train[0]
```

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0,
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0,
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0,
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0,
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0,
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0,
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0,
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224,
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0,
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0,
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0,
          0,   0]], dtype=uint8)
```

```
X_train
```

```
array([[[0, 0, 0, ..., 0, 0, 0],
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        ...,
        [0, 0, 0, ..., 0, 0, 0],
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        [0, 0, 0, ..., 0, 0, 0]],

       ...,

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        ...,
        [0, 0, 0, ..., 0, 0, 0],
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       [[0, 0, 0, ..., 0, 0, 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]]], dtype=uint8)
```

```
y_train[0]
```

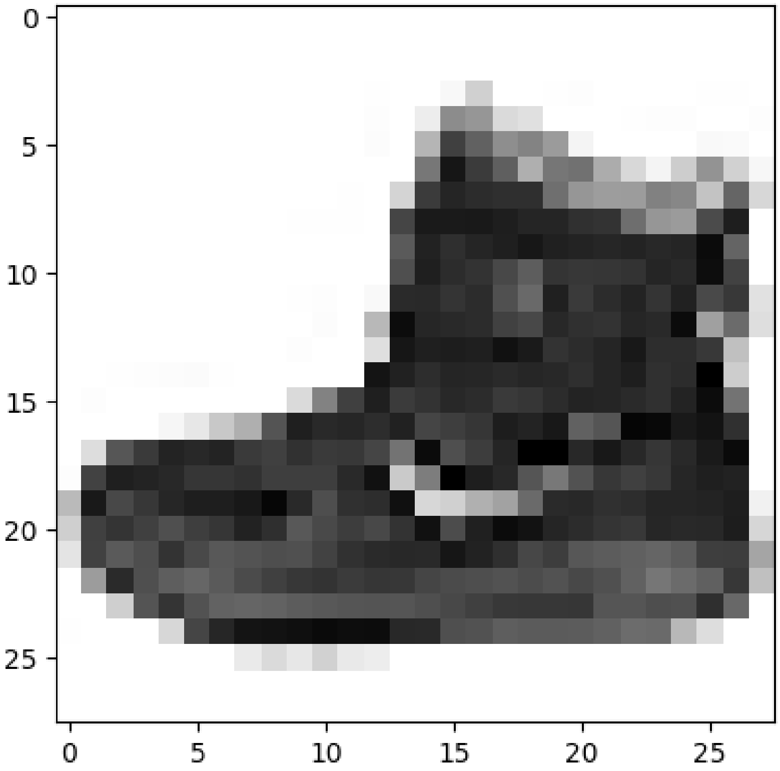
```
9
```

```
class_labels = 
["T-shirt/top","Trouser","Pullover","Dress","Coat","Sandal","Shirt","Sneaker","Bag","Ankle boot"]
'''
0 => T-shirt/top
1 => Trouser
2 => Pullover
3 => Dress
4 => Coat
5 => Sandal
6 => Shirt
7 => Sneaker
8 => Bag
9 => Ankle boot '''
```

```
{"type":"string"}
```

```
plt.imshow(X_train[0],cmap = "Greys")
```

```
<matplotlib.image.AxesImage at 0x7f178f50fe80>
```



```
plt.figure(figsize=(16,16))
j=1

for i in np.random.randint(0,1000,25):
  plt.subplot(5,5,j);
  j=j+1
  plt.imshow(X_train[i],cmap="Greys")
  plt.axis("off")
  plt.title('{}/{}'.format(class_labels[y_train[i]],y_train[i]))
```

```
X_train.ndim
```

```
3
```

Change 3d to 4d

```
X_train = np.expand_dims(X_train,-1)
X_test = np.expand_dims(X_test,-1)
```

```
X_train.shape
```

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

```
X_test.shape
```

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

Feature scale

```
X_train=X_train/255
X_test=X_test/255
```

```
X_train[0]
```

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        [0.        ],
        [0.        ],
        [0.        ]]])
```

split dataset

```
from sklearn.model_selection import train_test_split

X_train,X_val,y_train,y_val=train_test_split(X_train,y_train,test_size
=0.2,random_state=2020)

X_train.shape , y_train.shape

((48000, 28, 28, 1), (48000,))

X_val.shape,y_val.shape
```

```
((12000, 28, 28, 1), (12000,))
```

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

keras.layers.Conv2D(filters=32,kernel_size=3,strides=(1,1),padding='valid',activation='relu',input_shape=[28,28,1]),
    keras.layers.MaxPooling2D(pool_size=(2,2)),
    keras.layers.Flatten(),
    keras.layers.Dense(units=128, activation ='relu'),
    keras.layers.Dense(units=10,activation ='softmax'),
])
```

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 26, 26, 32)        320

 max_pooling2d (MaxPooling2  (None, 13, 13, 32)        0
 D)

 flatten (Flatten)           (None, 5408)              0

 dense (Dense)               (None, 128)               692352

 dense_1 (Dense)             (None, 10)                1290

=================================================================
Total params: 693962 (2.65 MB)
Trainable params: 693962 (2.65 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

```
model.compile(optimizer='adam',loss='sparse_categorical_crossentropy',
metrics=['accuracy'])
```

```
model.fit(X_train , y_train , epochs=20 , batch_size=512 ,verbose=1 ,
validation_data=(X_val,y_val))
```

```
Epoch 1/20
94/94 [==============================] - 5s 12ms/step - loss: 0.6261 -
accuracy: 0.7882 - val_loss: 0.4195 - val_accuracy: 0.8574
Epoch 2/20
94/94 [==============================] - 1s 7ms/step - loss: 0.3844 -
accuracy: 0.8664 - val_loss: 0.3880 - val_accuracy: 0.8641
Epoch 3/20
94/94 [==============================] - 1s 7ms/step - loss: 0.3327 -
accuracy: 0.8834 - val_loss: 0.3371 - val_accuracy: 0.8860
Epoch 4/20
```

```
94/94 [==============================] - 1s 8ms/step - loss: 0.3084 -
accuracy: 0.8916 - val_loss: 0.3168 - val_accuracy: 0.8910
Epoch 5/20
94/94 [==============================] - 1s 9ms/step - loss: 0.2853 -
accuracy: 0.8990 - val_loss: 0.3178 - val_accuracy: 0.8892
Epoch 6/20
94/94 [==============================] - 1s 9ms/step - loss: 0.2671 -
accuracy: 0.9054 - val_loss: 0.3007 - val_accuracy: 0.8975
Epoch 7/20
94/94 [==============================] - 1s 9ms/step - loss: 0.2555 -
accuracy: 0.9097 - val_loss: 0.2931 - val_accuracy: 0.8978
Epoch 8/20
94/94 [==============================] - 1s 7ms/step - loss: 0.2420 -
accuracy: 0.9150 - val_loss: 0.2809 - val_accuracy: 0.9045
Epoch 9/20
94/94 [==============================] - 1s 7ms/step - loss: 0.2281 -
accuracy: 0.9197 - val_loss: 0.2798 - val_accuracy: 0.9027
Epoch 10/20
94/94 [==============================] - 1s 8ms/step - loss: 0.2176 -
accuracy: 0.9236 - val_loss: 0.2762 - val_accuracy: 0.9071
Epoch 11/20
94/94 [==============================] - 1s 7ms/step - loss: 0.2109 -
accuracy: 0.9244 - val_loss: 0.2755 - val_accuracy: 0.9069
Epoch 12/20
94/94 [==============================] - 1s 7ms/step - loss: 0.2021 -
accuracy: 0.9280 - val_loss: 0.2888 - val_accuracy: 0.9008
Epoch 13/20
94/94 [==============================] - 1s 8ms/step - loss: 0.1925 -
accuracy: 0.9310 - val_loss: 0.2816 - val_accuracy: 0.9029
Epoch 14/20
94/94 [==============================] - 1s 8ms/step - loss: 0.1837 -
accuracy: 0.9349 - val_loss: 0.2696 - val_accuracy: 0.9087
Epoch 15/20
94/94 [==============================] - 1s 7ms/step - loss: 0.1802 -
accuracy: 0.9349 - val_loss: 0.2867 - val_accuracy: 0.8988
Epoch 16/20
94/94 [==============================] - 1s 10ms/step - loss: 0.1719 -
accuracy: 0.9384 - val_loss: 0.2594 - val_accuracy: 0.9118
Epoch 17/20
94/94 [==============================] - 1s 9ms/step - loss: 0.1612 -
accuracy: 0.9417 - val_loss: 0.2707 - val_accuracy: 0.9095
Epoch 18/20
94/94 [==============================] - 1s 11ms/step - loss: 0.1568 -
accuracy: 0.9442 - val_loss: 0.2713 - val_accuracy: 0.9087
Epoch 19/20
94/94 [==============================] - 1s 12ms/step - loss: 0.1499 -
accuracy: 0.9472 - val_loss: 0.2662 - val_accuracy: 0.9111
Epoch 20/20
```

```
94/94 [==============================] - 1s 7ms/step - loss: 0.1421 -
accuracy: 0.9495 - val_loss: 0.2777 - val_accuracy: 0.9090

<keras.src.callbacks.History at 0x7f174253d4e0>
```

test the model

```
model.predict(np.expand_dims(X_test[0],axis=0)).round(2)
```

```
1/1 [==============================] - 0s 191ms/step

array([[0., 0., 0., 0., 0., 0., 0., 0., 0., 1.]], dtype=float32)
```

```
np.argmax(model.predict(np.expand_dims(X_test[0] , axis=0)).round(2))
```

```
1/1 [==============================] - 0s 25ms/step

9
```

```
y_test[0]
```

```
9
```

```
np.argmax(model.predict(np.expand_dims(X_test[5] , axis =0)).round(2))
```

```
1/1 [==============================] - 0s 27ms/step

1
```

```
y_test[5]
```

```
1
```

```
y_pred = model.predict(X_test).round(2)
```

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

```
y_pred
```

```
array([[0.  , 0.  , 0.  , ..., 0.  , 0.  , 1.  ],
       [0.  , 0.  , 1.  , ..., 0.  , 0.  , 0.  ],
       [0.  , 1.  , 0.  , ..., 0.  , 0.  , 0.  ],
       ...,
       [0.  , 0.  , 0.  , ..., 0.  , 1.  , 0.  ],
       [0.  , 1.  , 0.  , ..., 0.  , 0.  , 0.  ],
       [0.  , 0.  , 0.  , ..., 0.02, 0.04, 0.  ]], dtype=float32)
```

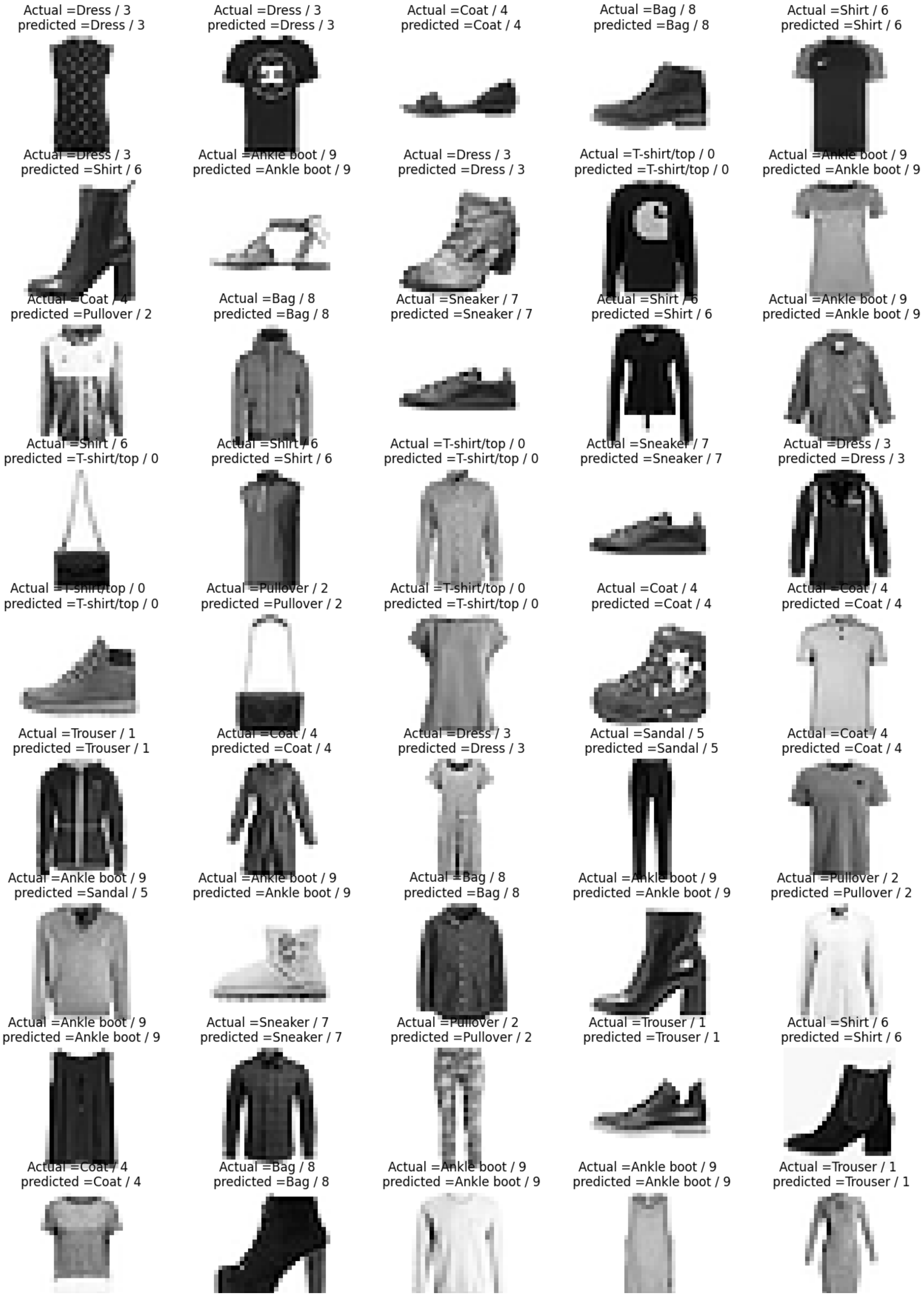
```
model.evaluate(X_test,y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.2808
- accuracy: 0.9019

[0.2807701826095581, 0.9018999934196472]
```

```
plt.figure(figsize=(16,30))

j=1
for i in np.random.randint(0,1000,60):
  plt.subplot(12,5,j);j=j+1
  plt.imshow(X_train[i].reshape(28,28),cmap="Greys")
  plt.title('Actual ={} / {} \n predicted ={} / {}'.format(class_labels[y_test[i]],y_test[i],class_labels[np.argmax(y_pred[i])],np.argmax(y_pred[i])))
  plt.axis('off')
```

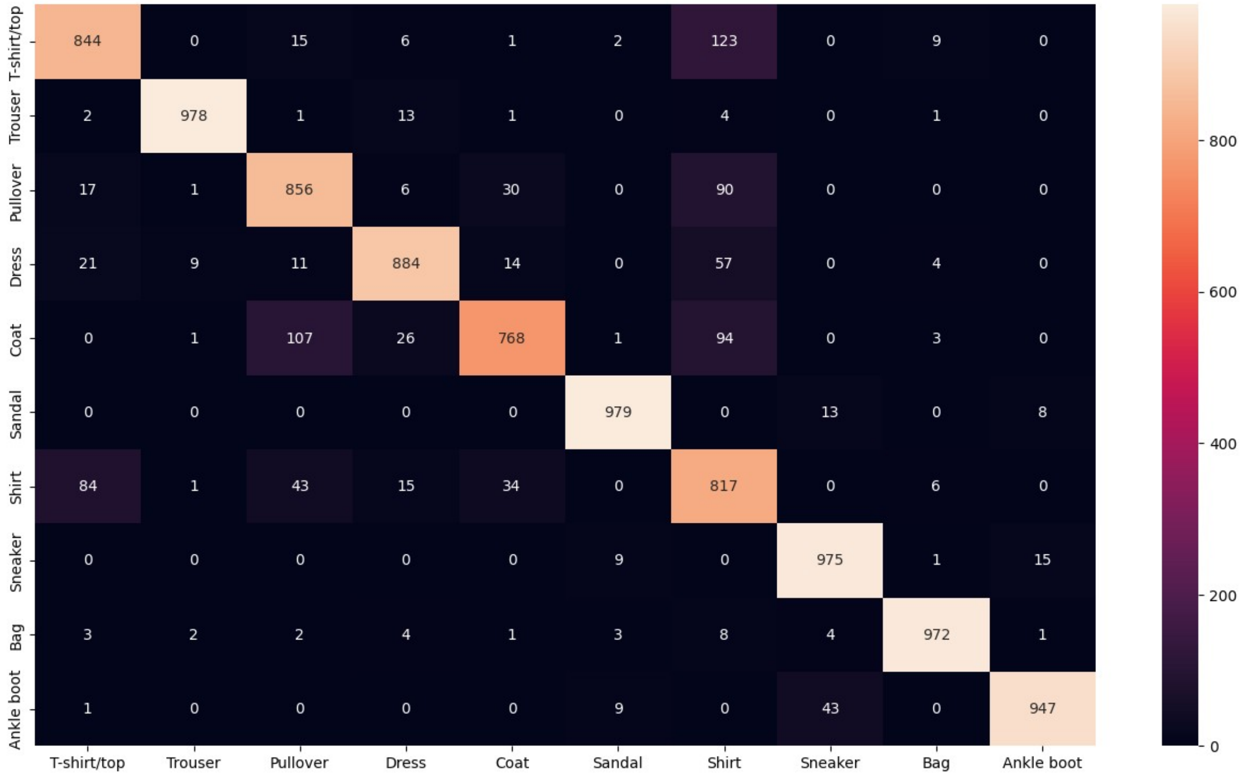

Actual =Dress / 3
predicted =Dress / 3
Actual =Dress / 3
predicted =Dress / 3
Actual =Coat / 4
predicted =Coat / 4
Actual =Bag / 8
predicted =Bag / 8
Actual =Shirt / 6
predicted =Shirt / 6
Actual =Dress / 3
predicted =Shirt / 6
Actual =Ankle boot / 9
predicted =Ankle boot / 9
Actual =Dress / 3
predicted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

confusion matrix

```
from sklearn.metrics import confusion_matrix

plt.figure(figsize=(16,9))
y_pred_labels=[np.argmax(labels) for labels in y_pred]
cm=confusion_matrix(y_test,y_pred_labels)
sns.heatmap(cm,annot=True,fmt='d',xticklabels=class_labels,yticklabels
=class_labels)

<Axes: >
```



	T-shirt/top	Trouser	Pullover	Dress	Coat	Sandal	Shirt	Sneaker	Bag	Ankle boot
T-shirt/top	844	0	15	6	1	2	123	0	9	0
Trouser	2	978	1	13	1	0	4	0	1	0
Pullover	17	1	856	6	30	0	90	0	0	0
Dress	21	9	11	884	14	0	57	0	4	0
Coat	0	1	107	26	768	1	94	0	3	0
Sandal	0	0	0	0	0	979	0	13	0	8
Shirt	84	1	43	15	34	0	817	0	6	0
Sneaker	0	0	0	0	0	9	0	975	1	15
Bag	3	2	2	4	1	3	8	4	972	1
Ankle boot	1	0	0	0	0	9	0	43	0	947

```
from sklearn.metrics import classification_report
cm=classification_report(y_test,y_pred_labels,target_names=class_label
s)
print(cm)

              precision    recall  f1-score   support

 T-shirt/top       0.87      0.84      0.86      1000
     Trouser       0.99      0.98      0.98      1000
    Pullover       0.83      0.86      0.84      1000
       Dress       0.93      0.88      0.90      1000
        Coat       0.90      0.77      0.83      1000
      Sandal       0.98      0.98      0.98      1000
       Shirt       0.68      0.82      0.75      1000
     Sneaker       0.94      0.97      0.96      1000
         Bag       0.98      0.97      0.97      1000
  Ankle boot       0.98      0.95      0.96      1000

    accuracy                           0.90     10000
   macro avg       0.91      0.90      0.90     10000
weighted avg       0.91      0.90      0.90     10000
```

save cnn

```
model.save('fasion_classification_cnn_model.h5')
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/engine/
training.py:3103: UserWarning: You are saving your model as an HDF5
file via `model.save()`. This file format is considered legacy. We
recommend using instead the native Keras format, e.g.
`model.save('my_model.keras')`.
  saving_api.save_model(
```

```
path='/content/drive/MyDrive/Fasion_classification_cnn_model.h5'
model.save(path)
```

```
model=keras.models.load_model('/content/drive/MyDrive/
Fasion_classification_cnn_model.h5')
```

```
model.predict(np.expand_dims(X_test[1],axis=0)).round(2)
```

```
1/1 [==============================] - 0s 47ms/step
```

```
array([[0., 0., 1., 0., 0., 0., 0., 0., 0., 0.]], dtype=float32)
```

```
pred=np.argmax(model.predict(np.expand_dims(X_test[1],axis=0)).round(2
))
```

```
1/1 [==============================] - 0s 39ms/step
```

```
2
```

```
y_test[1]
```

```
2
```

```
x=y=0
for i in range(300):
   if
(np.argmax(model.predict(np.expand_dims(X_test[i],axis=0)).round(2)) )
==y_test[i]:
       print('Valid prediction');
       x=x+1;
   else:
       print('Invalid prediction');
```

```
        y=y+1

print("Total valid prediction = ",x);
print("Total invalid prediction = ",y);
```

```
1/1 [==============================] - 0s 53ms/step
Valid prediction
1/1 [==============================] - 0s 58ms/step
Valid prediction
1/1 [==============================] - 0s 26ms/step
Valid prediction
1/1 [==============================] - 0s 55ms/step
Valid prediction
1/1 [==============================] - 0s 70ms/step
Valid prediction
1/1 [==============================] - 0s 25ms/step
Valid prediction
1/1 [==============================] - 0s 26ms/step
Valid prediction
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Total valid prediction =  278
Total invalid prediction =  22
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