```
In [15]: import numpy as np
         import pandas as pd
         import matplotlib.pyplot as plt
         from keras.models import Sequential
         from keras.layers import Convolution2D, MaxPooling2D, Flatten, Dropout, Dense
         from keras.utils import np_utils
         import tensorflow
```

```
In [17]: x_data = pd.read_csv('fashion-mnist_train.csv')
         test = pd.read_csv('fashion-mnist_test.csv')
```

```
In [42]: x_ = np.array(x_data)
         x = x_[:,1:]
         x = x/255.0
         y = x_[:,0]

         test_ = np.array(test)
         x_t =  test_[:,1:]
         x_t = x_t/255.0
         y_t = test_[:,0]
```

```
In [43]: #reshaping for network

         x_train = x.reshape((-1,28,28,1))
         y_train = np_utils.to_categorical(y)  # to create one hot notation
         print(x_train.shape, y_train.shape)

         x_test = x_t.reshape((-1,28,28,1))
         y_test = np_utils.to_categorical(y_t)  # to create one hot notation
         print(x_test.shape, y_test.shape)
```

```
(60000, 28, 28, 1) (60000, 10)
(10000, 28, 28, 1) (10000, 10)
```

```
In [ ]:
```

```
In [ ]:
```

```
In [ ]:
```

```
In [28]: #creating CNN model
         model = Sequential()
         model.add(Convolution2D(32,(3,3), activation = 'relu', input_shape = (28,28,1)))
         model.add(Convolution2D(64,(3,3), activation = 'relu'))
         model.add(Dropout(.25))
         model.add(MaxPooling2D(2,2))

         model.add(Convolution2D(128,(3,3), activation = 'relu'))
         model.add(Convolution2D(64,(3,3), activation = 'relu'))
         model.add(Dropout(.25))
         model.add(MaxPooling2D(2,2))

         model.add(Convolution2D(32,(2,2), activation = 'relu'))
         model.add(Convolution2D(16,(2,2), activation = 'relu', data_format = 'channels_first'))
         model.add(Flatten())

         model.add(Dense(10,activation = 'softmax'))

         model.summary()
```

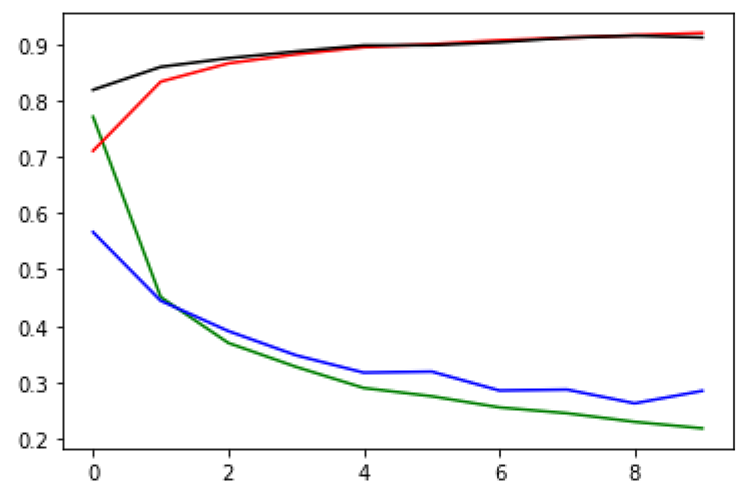
```
Model: "sequential_8"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d_39 (Conv2D)           (None, 26, 26, 32)        320       
_________________________________________________________________
conv2d_40 (Conv2D)           (None, 24, 24, 64)        18496     
_________________________________________________________________
dropout_13 (Dropout)         (None, 24, 24, 64)        0         
_________________________________________________________________
max_pooling2d_13 (MaxPooling (None, 12, 12, 64)        0         
_________________________________________________________________
conv2d_41 (Conv2D)           (None, 10, 10, 128)       73856     
_________________________________________________________________
conv2d_42 (Conv2D)           (None, 8, 8, 64)          73792     
_________________________________________________________________
dropout_14 (Dropout)         (None, 8, 8, 64)          0         
_________________________________________________________________
max_pooling2d_14 (MaxPooling (None, 4, 4, 64)          0         
_________________________________________________________________
conv2d_43 (Conv2D)           (None, 3, 3, 32)          8224      
_________________________________________________________________
conv2d_44 (Conv2D)           (None, 16, 2, 31)         208       
_________________________________________________________________
flatten_4 (Flatten)          (None, 992)               0         
_________________________________________________________________
dense_4 (Dense)              (None, 10)                9930      
=================================================================
Total params: 184,826
Trainable params: 184,826
Non-trainable params: 0
_________________________________________________________________
```

```
In [29]: model.compile(loss ='categorical_crossentropy', optimizer = 'adam', metrics = ['accuracy'])
```

```
In [30]: hist = model.fit(x_train, y_train, epochs = 10, shuffle = True, batch_size = 256, validation_split = 0.
         2)
```

```
Train on 48000 samples, validate on 12000 samples
Epoch 1/10
48000/48000 [==============================] - 68s 1ms/step - loss: 0.7709 - accuracy: 0.7106 - val_l
oss: 0.5663 - val_accuracy: 0.8188
Epoch 2/10
48000/48000 [==============================] - 73s 2ms/step - loss: 0.4511 - accuracy: 0.8334 - val_l
oss: 0.4445 - val_accuracy: 0.8596
Epoch 3/10
48000/48000 [==============================] - 65s 1ms/step - loss: 0.3696 - accuracy: 0.8659 - val_l
oss: 0.3907 - val_accuracy: 0.8750
Epoch 4/10
48000/48000 [==============================] - 64s 1ms/step - loss: 0.3272 - accuracy: 0.8819 - val_l
oss: 0.3478 - val_accuracy: 0.8869
Epoch 5/10
48000/48000 [==============================] - 64s 1ms/step - loss: 0.2897 - accuracy: 0.8945 - val_l
oss: 0.3170 - val_accuracy: 0.8978
Epoch 6/10
48000/48000 [==============================] - 64s 1ms/step - loss: 0.2750 - accuracy: 0.8998 - val_l
oss: 0.3188 - val_accuracy: 0.8980
Epoch 7/10
48000/48000 [==============================] - 66s 1ms/step - loss: 0.2553 - accuracy: 0.9068 - val_l
oss: 0.2852 - val_accuracy: 0.9033
Epoch 8/10
48000/48000 [==============================] - 61s 1ms/step - loss: 0.2449 - accuracy: 0.9114 - val_l
oss: 0.2868 - val_accuracy: 0.9113
Epoch 9/10
48000/48000 [==============================] - 61s 1ms/step - loss: 0.2296 - accuracy: 0.9158 - val_l
oss: 0.2625 - val_accuracy: 0.9149
Epoch 10/10
48000/48000 [==============================] - 61s 1ms/step - loss: 0.2181 - accuracy: 0.9197 - val_l
oss: 0.2846 - val_accuracy: 0.9118
```

```
In [44]: plt.figure(0)
         plt.plot(hist.history['loss'], 'g')
         plt.plot(hist.history['val_loss'], 'b')
         plt.plot(hist.history['accuracy'], 'r')
         plt.plot(hist.history['val_accuracy'], 'black')
         plt.show()
```



```
In [45]: hist.history.keys()

Out[45]: dict_keys(['val_loss', 'val_accuracy', 'loss', 'accuracy'])
```

```
In [46]: print(np.mean(hist.history['accuracy']), np.mean(hist.history['val_accuracy']))
```

```
0.873975 0.8877499997615814
```

```
In [47]: len(hist.history['accuracy'])

Out[47]: 10
```

```
In [48]: model.evaluate(x_test,y_test)
```

```
10000/10000 [==============================] - 3s 311us/step
```

```
Out[48]: [0.2774016491174698, 0.9147999882698059]
```

```
In [ ]:
```