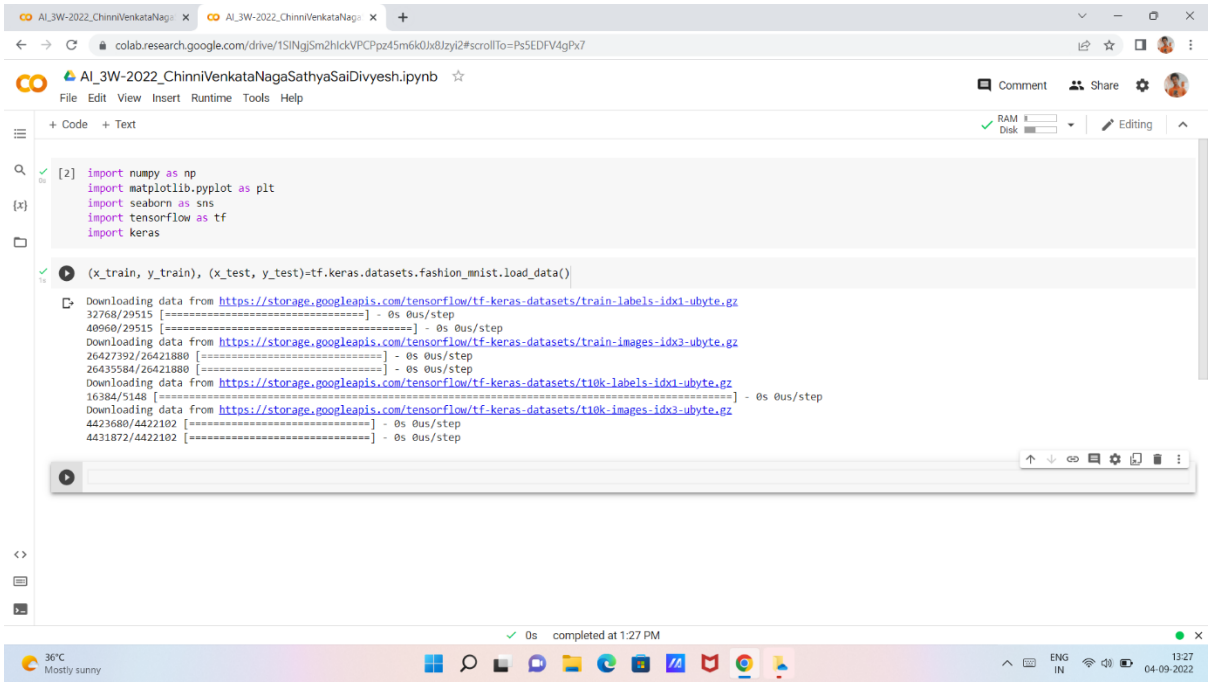
AI_3W-2022_ChinniVenkataNaga
colab.research.google.com/drive/1SlNgjSm2hlckVPCPpz45m6k0Jx8Jzyi2#scrollTo=Ps5EDFV4gPx7
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[2] import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import tensorflow as tf
import keras
(x_train, y_train), (x_test, y_test)=tf.keras.datasets.fashion_mnist.load_data()
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-labels-idx1-ubyte.gz
32768/29515 [==========] - 0s 0us/step
40960/29515 [==========] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-images-idx3-ubyte.gz
26427392/26421880 [==========] - 0s 0us/step
26435584/26421880 [==========] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-labels-idx1-ubyte.gz
16384/5148 [==========] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-images-idx3-ubyte.gz
4423680/4422102 [==========] - 0s 0us/step
4431872/4422102 [==========] - 0s 0us/step
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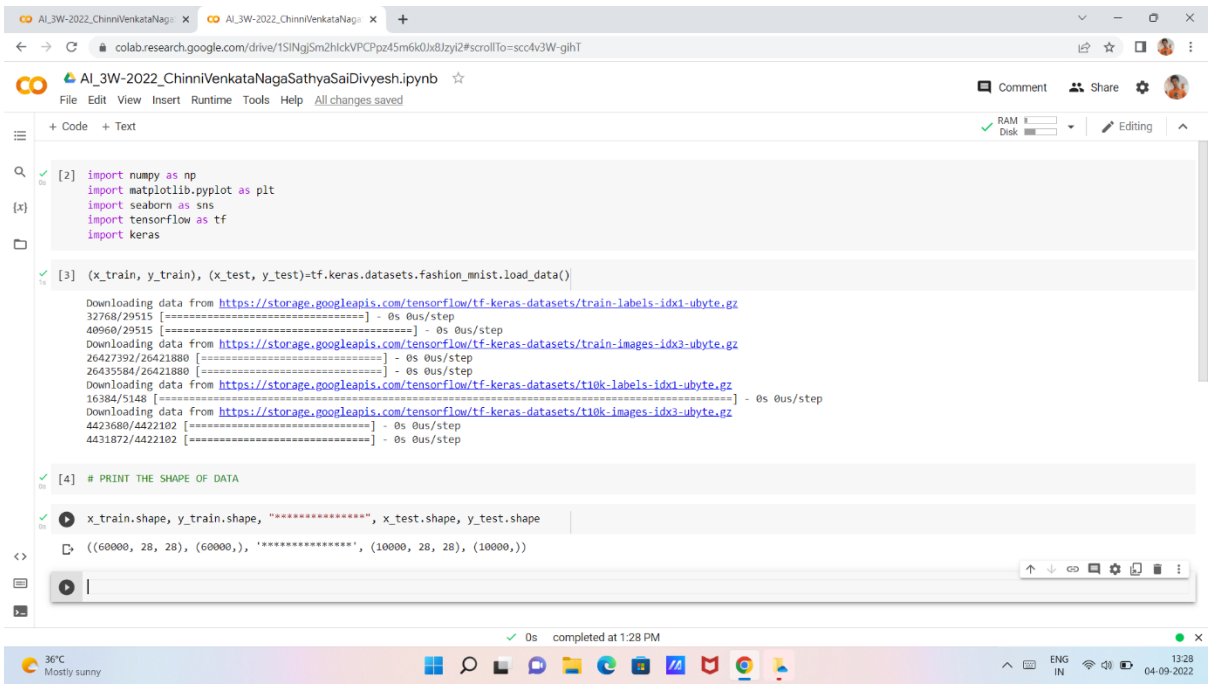
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[2] import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import tensorflow as tf
import keras
[3] (x_train, y_train), (x_test, y_test)=tf.keras.datasets.fashion_mnist.load_data()
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-labels-idx1-ubyte.gz
32768/29515 [==========] - 0s 0us/step
40960/29515 [==========] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/train-images-idx3-ubyte.gz
26427392/26421880 [==========] - 0s 0us/step
26435584/26421880 [==========] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-labels-idx1-ubyte.gz
16384/5148 [==========] - 0s 0us/step
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/t10k-images-idx3-ubyte.gz
4423680/4422102 [==========] - 0s 0us/step
4431872/4422102 [==========] - 0s 0us/step
[4] # PRINT THE SHAPE OF DATA
x_train.shape, y_train.shape, "**************", x_test.shape, y_test.shape
((60000, 28, 28), (60000,), '**************', (10000, 28, 28), (10000,))
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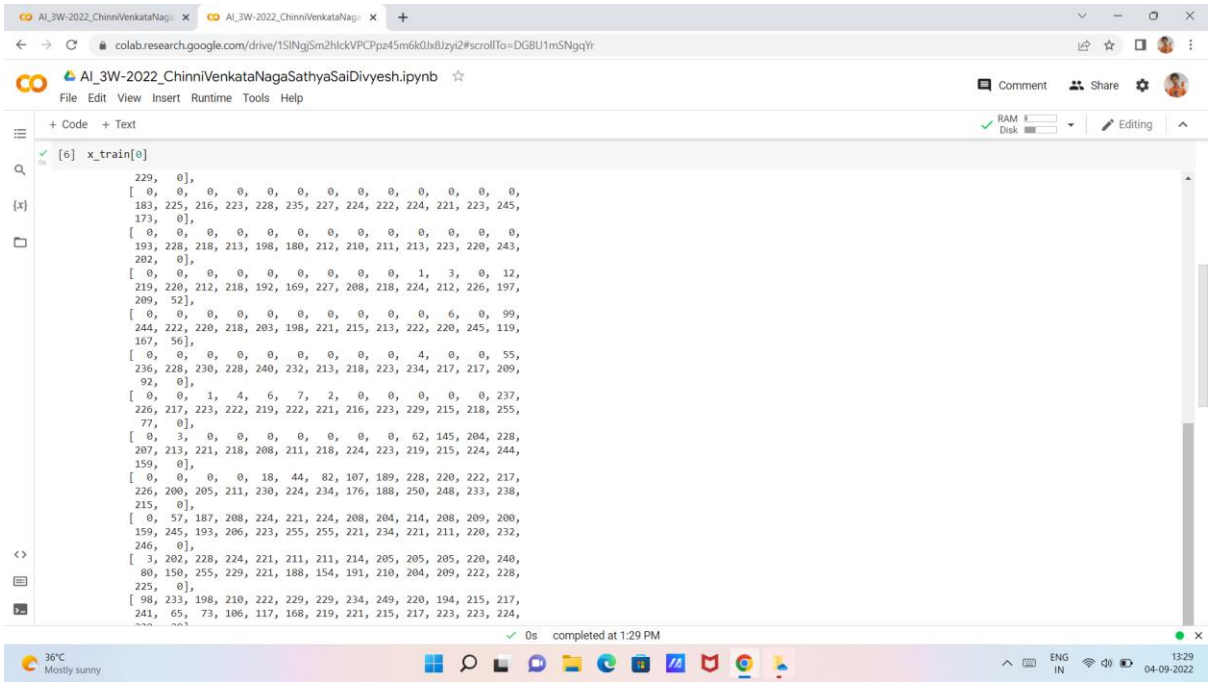
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[6] x_train[0]
229, 0],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
183, 225, 216, 223, 228, 235, 227, 224, 222, 224, 221, 223, 245,
173, 0],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
193, 228, 218, 213, 198, 180, 212, 210, 211, 213, 223, 220, 243,
202, 0],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 3, 0, 12,
219, 220, 212, 218, 192, 169, 227, 208, 218, 224, 212, 226, 197,
209, 52],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 6, 0, 99,
244, 222, 220, 218, 203, 198, 221, 215, 213, 222, 220, 245, 119,
167, 56],
[0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 0, 0, 55,
236, 228, 230, 228, 240, 232, 213, 218, 223, 234, 217, 217, 209,
92, 0],
[0, 0, 1, 4, 6, 7, 2, 0, 0, 0, 0, 0, 237,
226, 217, 223, 222, 219, 222, 221, 216, 223, 229, 215, 218, 255,
77, 0],
[0, 3, 0, 0, 0, 0, 0, 0, 0, 62, 145, 204, 228,
207, 213, 221, 218, 208, 211, 218, 224, 223, 219, 215, 224, 244,
159, 0],
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226, 200, 205, 211, 230, 224, 234, 176, 188, 250, 248, 233, 238,
215, 0],
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159, 245, 193, 206, 223, 255, 255, 221, 234, 221, 211, 220, 232,
246, 0],
[3, 202, 228, 224, 221, 211, 211, 214, 205, 205, 205, 220, 240,
80, 150, 255, 229, 221, 188, 154, 191, 210, 204, 209, 222, 228,
225, 0],
[98, 233, 198, 210, 222, 229, 229, 234, 249, 220, 194, 215, 217,
241, 65, 73, 106, 117, 168, 219, 221, 215, 217, 223, 223, 224,
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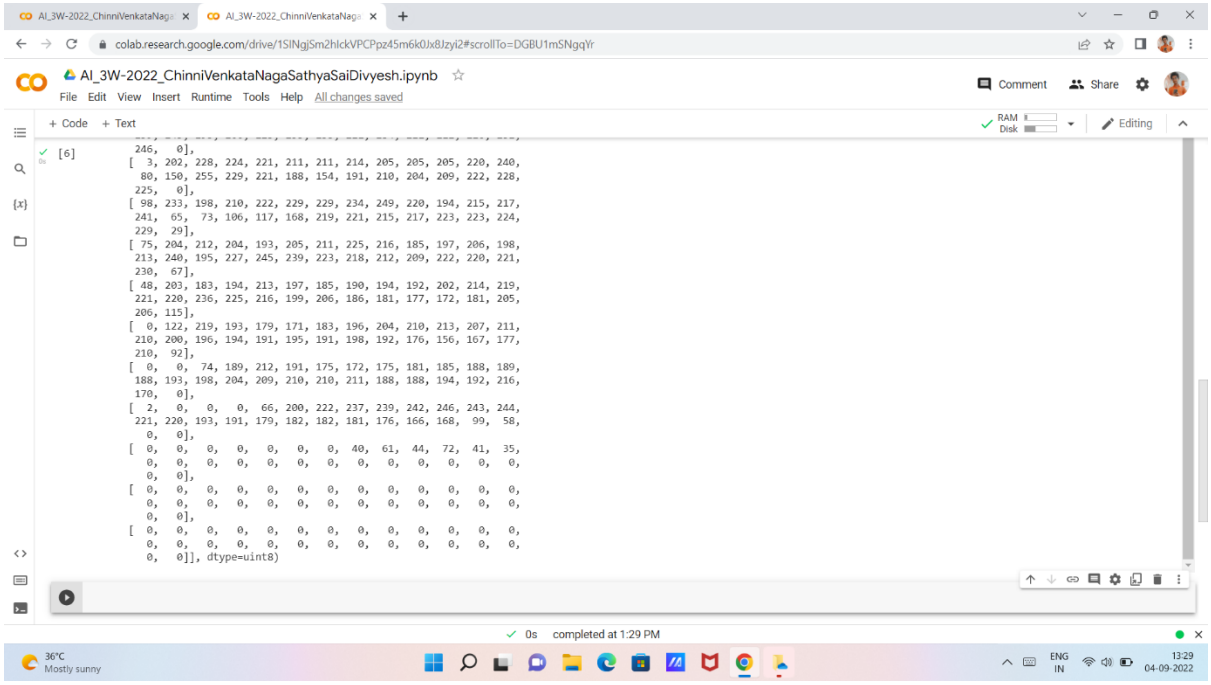
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[6]
246, 0],
[3, 202, 228, 224, 221, 211, 211, 214, 205, 205, 205, 220, 240,
80, 150, 255, 229, 221, 188, 154, 191, 210, 204, 209, 222, 228,
225, 0],
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241, 65, 73, 106, 117, 168, 219, 221, 215, 217, 223, 223, 224,
229, 29],
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206, 115],
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210, 92],
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221, 220, 193, 191, 179, 182, 182, 181, 176, 166, 168, 99, 58,
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,
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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]], dtype=uint8)
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```
[6]       [ 0,  0,  0,  0,  0,  0,  0, 40, 61, 44, 72, 41, 35,
            0,  0,  0,  0,  0,  0,  0,  0,  0,  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]], dtype=uint8)
```

```
[7] y_train[0]
```

```
9
```

```
[8] class_labels=["T-shirt/top", "Trouser", "Pullover", "Dress", "Coat", "Sandal", "Shirt", "Sneaker", "Bag", "Ankle boot"]
```

```
[9] class_labels
```

```
['T-shirt/top',
 'Trouser',
 'Pullover',
 'Dress',
 'Coat',
 'Sandal',
 'Shirt',
 'Sneaker',
 'Bag',
 'Ankle boot']
```

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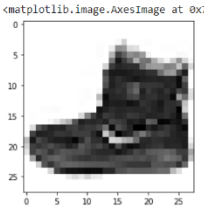
```
[9]   'Sandal',
      'Shirt',
      'Sneaker',
      'Bag',
      'Ankle boot']
```

```
[10] # SHOW IMAGE
```

```
[11] plt.imshow(x_train[0], cmap='Greys')
```

```
<matplotlib.image.AxesImage at 0x7f9a9e6cd1d0>
```



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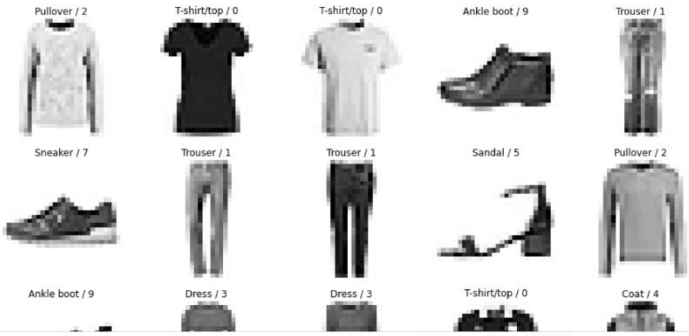
```
[12] plt.figure(figsize=(16,16))
     j=1
     for i in np.random.randint(0,1000,25):
       plt.subplot(5,5,j)
       j+=1
       plt.imshow(x_train[i], cmap='Greys')
       plt.axis('off')
       plt.title('{} / {}'.format(class_labels[y_train[i]], y_train[i]))
```



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[12]

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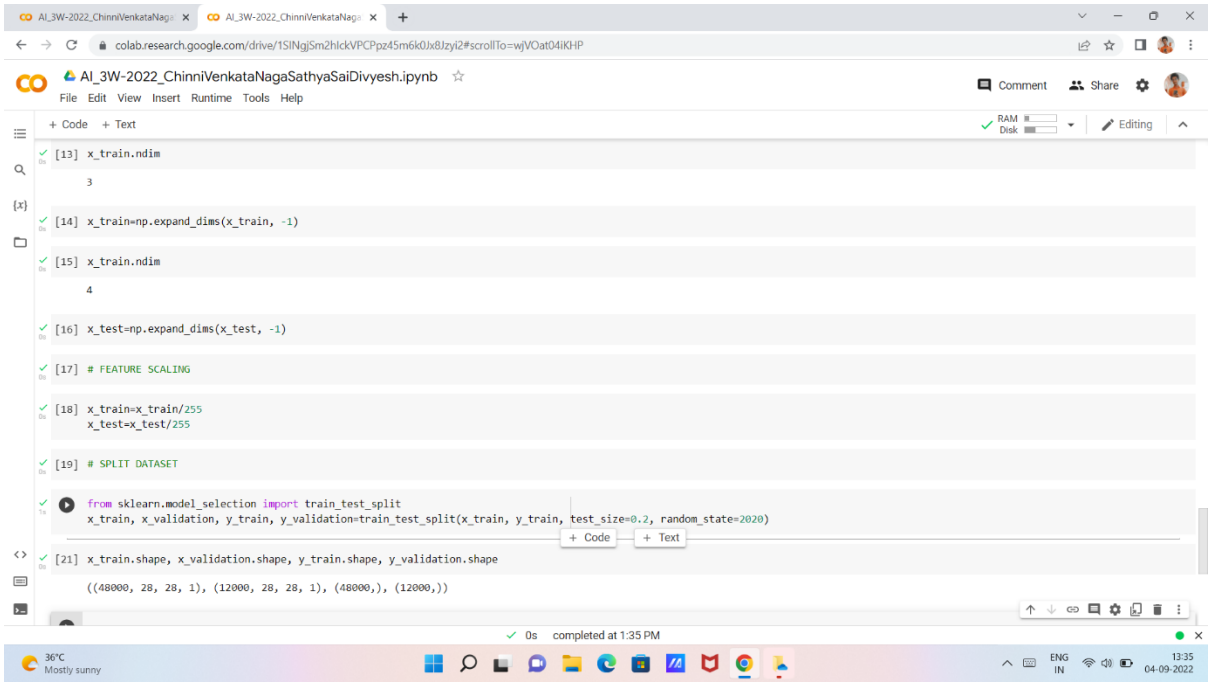
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[13] x_train.ndim
3
[14] x_train=np.expand_dims(x_train, -1)
[15] x_train.ndim
4
[16] x_test=np.expand_dims(x_test, -1)
[17] # FEATURE SCALING
[18] x_train=x_train/255
x_test=x_test/255
[19] # SPLIT DATASET
from sklearn.model_selection import train_test_split
x_train, x_validation, y_train, y_validation=train_test_split(x_train, y_train, test_size=0.2, random_state=2020)
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[21] x_train.shape, x_validation.shape, y_train.shape, y_validation.shape
((48000, 28, 28, 1), (12000, 28, 28, 1), (48000,), (12000,))
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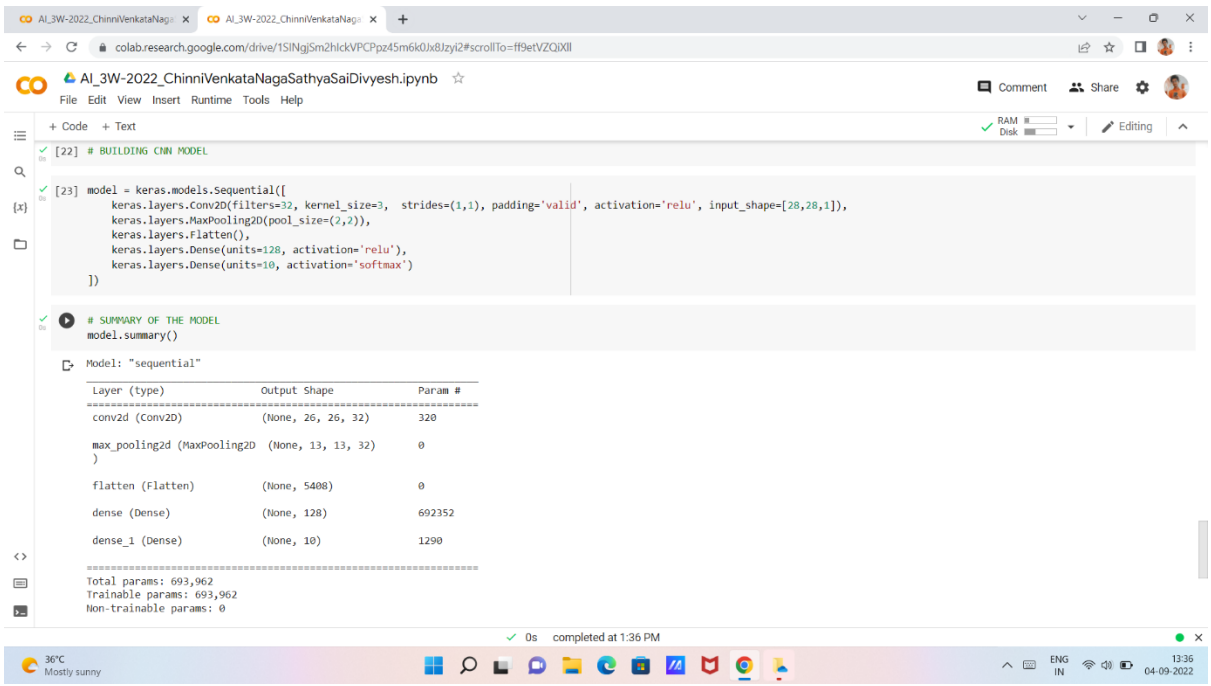
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[22] # BUILDING CNN MODEL
[23] model = keras.models.Sequential([
keras.layers.Conv2D(filters=32, kernel_size=3, strides=(1,1), padding='valid', activation='relu', input_shape=[28,28,1]),
keras.layers.MaxPooling2D(pool_size=(2,2)),
keras.layers.Flatten(),
keras.layers.Dense(units=128, activation='relu'),
keras.layers.Dense(units=10, activation='softmax')
])
# SUMMARY OF THE MODEL
model.summary()
Model: "sequential"
Layer (type) Output Shape Param #
conv2d (Conv2D) (None, 26, 26, 32) 320
max_pooling2d (MaxPooling2D (None, 13, 13, 32) 0
)
flatten (Flatten) (None, 5408) 0
dense (Dense) (None, 128) 692352
dense_1 (Dense) (None, 10) 1290
Total params: 693,962
Trainable params: 693,962
Non-trainable params: 0
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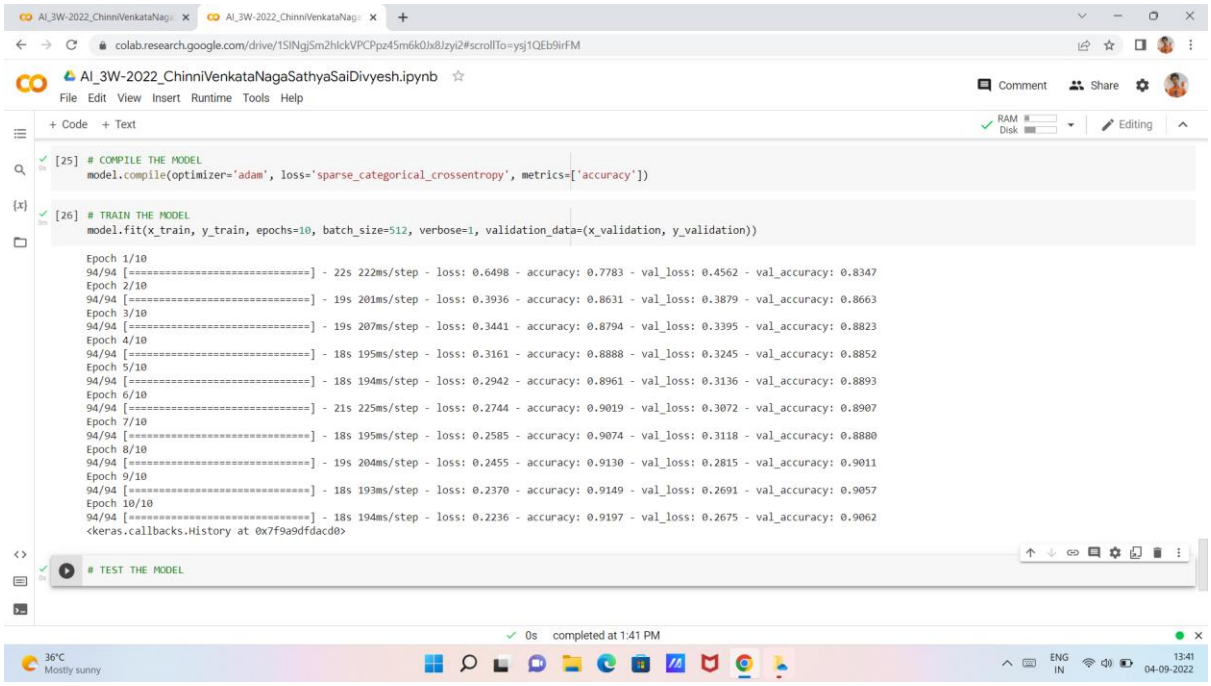
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[25] # COMPILE THE MODEL
model.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])
[26] # TRAIN THE MODEL
model.fit(x_train, y_train, epochs=10, batch_size=512, verbose=1, validation_data=(x_validation, y_validation))
Epoch 1/10
94/94 [==============================] - 22s 222ms/step - loss: 0.6498 - accuracy: 0.7783 - val_loss: 0.4562 - val_accuracy: 0.8347
Epoch 2/10
94/94 [==============================] - 19s 201ms/step - loss: 0.3936 - accuracy: 0.8631 - val_loss: 0.3879 - val_accuracy: 0.8663
Epoch 3/10
94/94 [==============================] - 19s 207ms/step - loss: 0.3441 - accuracy: 0.8794 - val_loss: 0.3395 - val_accuracy: 0.8823
Epoch 4/10
94/94 [==============================] - 18s 195ms/step - loss: 0.3161 - accuracy: 0.8888 - val_loss: 0.3245 - val_accuracy: 0.8852
Epoch 5/10
94/94 [==============================] - 18s 194ms/step - loss: 0.2942 - accuracy: 0.8961 - val_loss: 0.3136 - val_accuracy: 0.8893
Epoch 6/10
94/94 [==============================] - 21s 225ms/step - loss: 0.2744 - accuracy: 0.9019 - val_loss: 0.3072 - val_accuracy: 0.8907
Epoch 7/10
94/94 [==============================] - 18s 195ms/step - loss: 0.2585 - accuracy: 0.9074 - val_loss: 0.3118 - val_accuracy: 0.8880
Epoch 8/10
94/94 [==============================] - 19s 204ms/step - loss: 0.2455 - accuracy: 0.9130 - val_loss: 0.2815 - val_accuracy: 0.9011
Epoch 9/10
94/94 [==============================] - 18s 193ms/step - loss: 0.2370 - accuracy: 0.9149 - val_loss: 0.2691 - val_accuracy: 0.9057
Epoch 10/10
94/94 [==============================] - 18s 194ms/step - loss: 0.2236 - accuracy: 0.9197 - val_loss: 0.2675 - val_accuracy: 0.9062
<keras.callbacks.History at 0x7f9a9dfdacd0>
TEST THE MODEL
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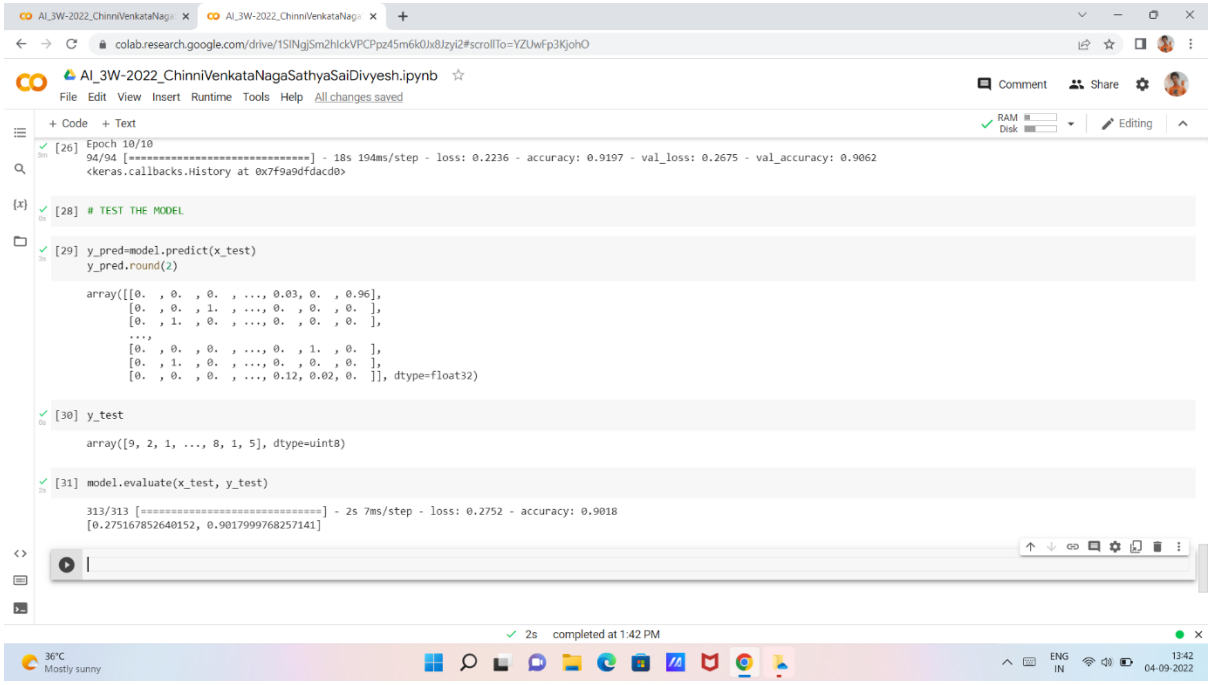
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[26] Epoch 10/10
94/94 [==============================] - 18s 194ms/step - loss: 0.2236 - accuracy: 0.9197 - val_loss: 0.2675 - val_accuracy: 0.9062
<keras.callbacks.History at 0x7f9a9dfdacd0>
[28] # TEST THE MODEL
[29] y_pred=model.predict(x_test)
y_pred.round(2)
array([[0. , 0. , 0. , ..., 0.03, 0. , 0.96],
[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. , ..., 0.12, 0.02, 0.]], dtype=float32)
[30] y_test
array([9, 2, 1, ..., 8, 1, 5], dtype=uint8)
[31] model.evaluate(x_test, y_test)
313/313 [==============================] - 2s 7ms/step - loss: 0.2752 - accuracy: 0.9018
[0.275167852640152, 0.9017999768257141]
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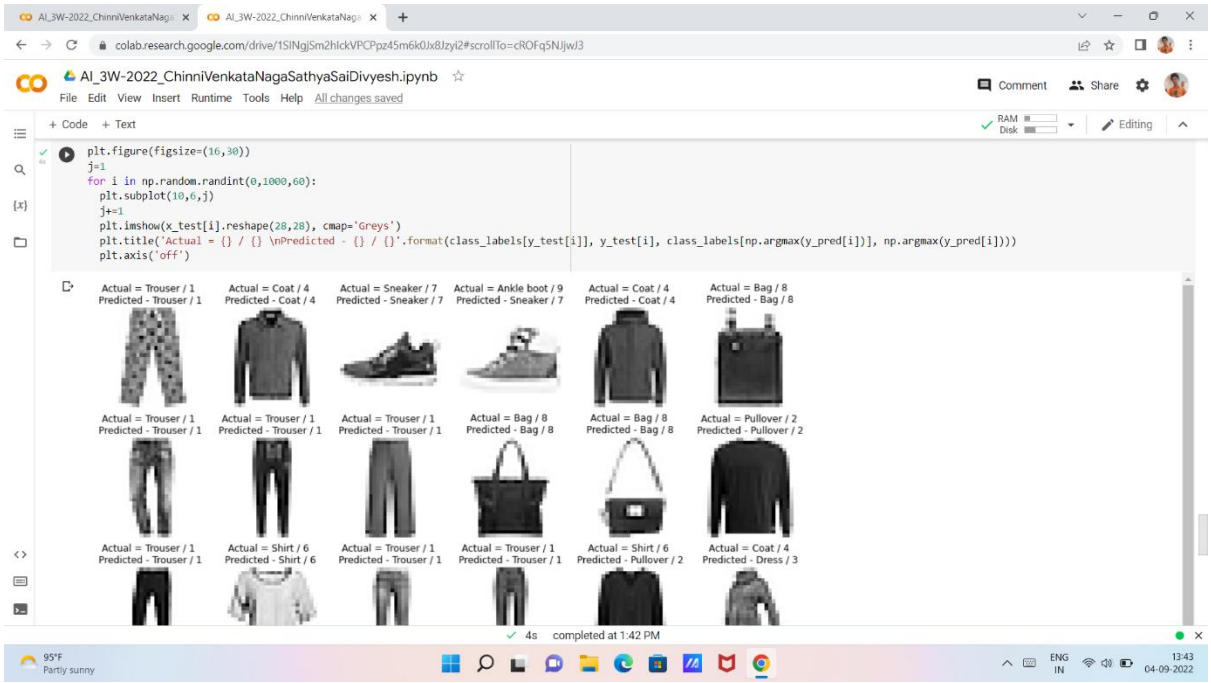
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plt.figure(figsize=(16,30))
j=1
for i in np.random.randint(0,1000,60):
plt.subplot(10,6,j)
j+=1
plt.imshow(x_test[i].reshape(28,28), cmap='Greys')
plt.title('Actual = {} / {} \nPredicted - {} / {}'.format(class_labels[y_test[i]], y_test[i], class_labels[np.argmax(y_pred[i])], np.argmax(y_pred[i])))
plt.axis('off')
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Coat / 4 Predicted - Coat / 4
Actual = Sneaker / 7 Predicted - Sneaker / 7
Actual = Ankle boot / 9 Predicted - Sneaker / 7
Actual = Coat / 4 Predicted - Coat / 4
Actual = Bag / 8 Predicted - Bag / 8
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Bag / 8 Predicted - Bag / 8
Actual = Bag / 8 Predicted - Bag / 8
Actual = Pullover / 2 Predicted - Pullover / 2
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Shirt / 6 Predicted - Shirt / 6
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Shirt / 6 Predicted - Pullover / 2
Actual = Coat / 4 Predicted - Dress / 3
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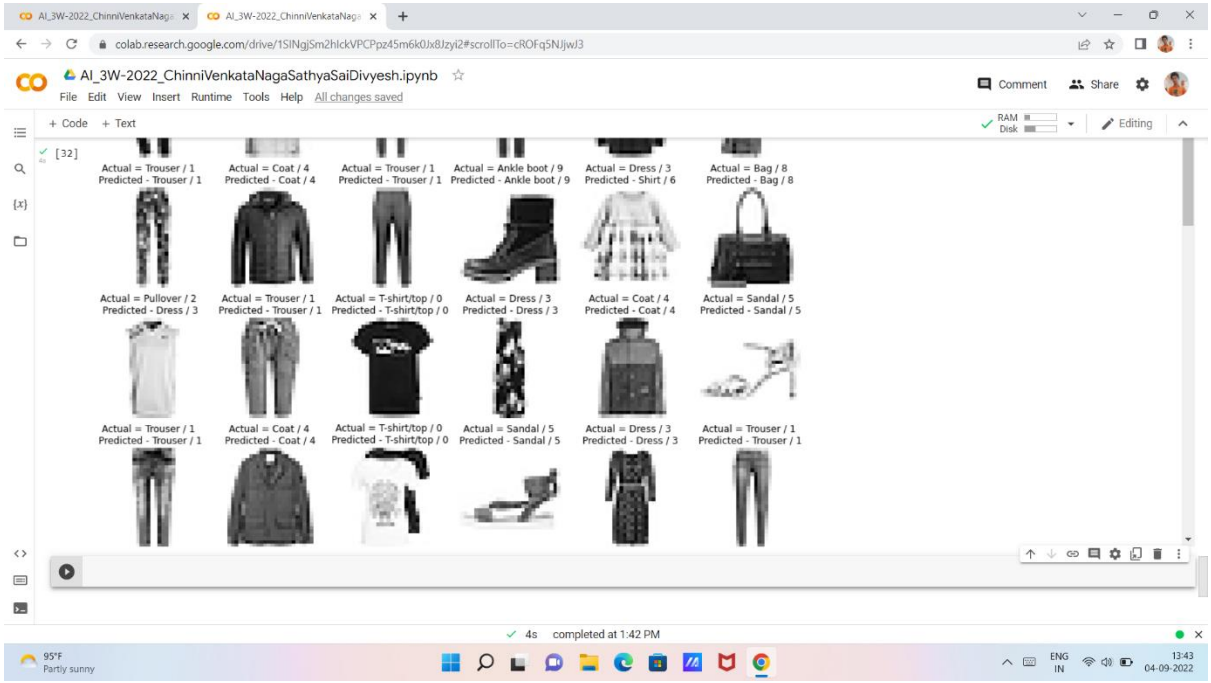
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[32]
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Coat / 4 Predicted - Coat / 4
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Ankle boot / 9 Predicted - Ankle boot / 9
Actual = Dress / 3 Predicted - Shirt / 6
Actual = Bag / 8 Predicted - Bag / 8
Actual = Pullover / 2 Predicted - Dress / 3
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = T-shirt/top / 0 Predicted - T-shirt/top / 0
Actual = Dress / 3 Predicted - Dress / 3
Actual = Coat / 4 Predicted - Coat / 4
Actual = Sandal / 5 Predicted - Sandal / 5
Actual = Trouser / 1 Predicted - Trouser / 1
Actual = Coat / 4 Predicted - Coat / 4
Actual = T-shirt/top / 0 Predicted - T-shirt/top / 0
Actual = Sandal / 5 Predicted - Sandal / 5
Actual = Dress / 3 Predicted - Dress / 3
Actual = Trouser / 1 Predicted - Trouser / 1
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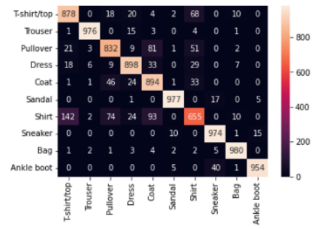
```
[33] # EVALUATE THE MODEL
     # CONFUSION MATRIX

[34] from sklearn.metrics import confusion_matrix
     plt.figure(figsize=(16,9))
     y_pred_labels=[np.argmax(label) for label in y_pred]
     cm=confusion_matrix(y_test, y_pred_labels)
```

```
<Figure size 1152x648 with 0 Axes>
```

```
# SHOW THE CONFUSION MATRIX
sns.heatmap(cm, annot=True, fmt='d', xticklabels=class_labels, yticklabels=class_labels)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9a92f50ed0>
```



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```
[35]
```

```
# SHOW THE CLASSIFICATION REPORT
from sklearn.metrics import classification_report
cr=classification_report(y_test, y_pred_labels, target_names=class_labels)
print(cr)
```

```
              precision    recall  f1-score   support

 T-shirt/top       0.83      0.88      0.85      1000
     Trouser       0.99      0.98      0.98      1000
    Pullover       0.85      0.83      0.84      1000
       Dress       0.90      0.90      0.90      1000
        Coat       0.80      0.89      0.85      1000
      Sandal       0.98      0.98      0.98      1000
       Shirt       0.78      0.66      0.71      1000
     Sneaker       0.94      0.97      0.96      1000
         Bag       0.97      0.98      0.97      1000
  Ankle boot       0.98      0.95      0.97      1000

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

```
[37] # SAVE THE MODEL

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

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