In [45]:

```python
import tensorflow as tf
from tensorflow import keras
tf.__version__
keras.__version__
```

Out[45]:

```
'2.9.0'
```

In [46]:

```python
df = keras.datasets.fashion_mnist
(X_train, y_train), (X_test, y_test) = df.load_data()
```

In [47]:

```python
X_train = X_train.reshape(60000, 784) / 255.0
X_test = X_test.reshape(10000, 784) / 255.0
```

## Model1

In [48]:

```python
model1 = keras.models.Sequential()
model1.add(keras.layers.Flatten())
model1.add(keras.layers.Flatten(input_shape=[28, 28]))
model1.add(keras.layers.Dense(4, activation='relu'))
model1.add(tf.keras.layers.Dense(10, activation='softmax'))
```

In [49]:

```python
model1.compile(loss="sparse_categorical_crossentropy", metrics=["accuracy"], optimizer="sgd")
history = model1.fit(X_train, y_train, epochs=10, validation_split=0.30)
```

```
Epoch 1/10
1313/1313 [==============================] - 4s 3ms/step - loss: 1.5658 - accuracy: 0.4775 - val_loss: 1.1089 - val_accuracy: 0.6370
Epoch 2/10
1313/1313 [==============================] - 4s 3ms/step - loss: 0.9037 - accuracy: 0.6862 - val_loss: 0.7887 - val_accuracy: 0.7128
Epoch 3/10
1313/1313 [==============================] - 3s 2ms/step - loss: 0.7414 - accuracy: 0.7393 - val_loss: 0.7108 - val_accuracy: 0.7501
Epoch 4/10
1313/1313 [==============================] - 4s 3ms/step - loss: 0.6810 - accuracy: 0.7676 - val_loss: 0.6640 - val_accuracy: 0.7729
Epoch 5/10
1313/1313 [==============================] - 4s 3ms/step - loss: 0.6435 - accuracy: 0.7813 - val_loss: 0.6790 - val_accuracy: 0.7477
Epoch 6/10
1313/1313 [==============================] - 3s 2ms/step - loss: 0.6175 - accuracy: 0.7922 - val_loss: 0.6062 - val_accuracy: 0.7954
Epoch 7/10
1313/1313 [==============================] - 3s 2ms/step - loss: 0.5985 - accuracy: 0.7959 - val_loss: 0.5937 - val_accuracy: 0.8018
Epoch 8/10
1313/1313 [==============================] - 3s 3ms/step - loss: 0.5826 - accuracy: 0.8022 - val_loss: 0.6084 - val_accuracy: 0.7862
Epoch 9/10
1313/1313 [==============================] - 4s 3ms/step - loss: 0.5710 - accuracy: 0.8058 - val_loss: 0.5697 - val_accuracy: 0.8062
Epoch 10/10
1313/1313 [==============================] - 3s 2ms/step - loss: 0.5608 - accuracy: 0.8089 - val_loss: 0.5740 - val_accuracy: 0.8051
```

## Model1 evaluation

In [50]:

```
model1.evaluate(X_test, y_test)
```

313/313 [==============================] - 1s 2ms/step - loss: 0.5957 - accuracy: 0.7966

Out[50]:

```
[0.5957294702529907, 0.7965999841690063]
```

In [51]:

```
X_new = X_test[:3]
y_proba = model1.predict(X_new)
y_proba.round(2)
```

1/1 [==============================] - 0s 57ms/step

Out[51]:

```
array([[0.  , 0.  , 0.  , 0.  , 0.  , 0.33, 0.  , 0.19, 0.  , 0.47],
       [0.  , 0.  , 0.66, 0.  , 0.19, 0.  , 0.15, 0.  , 0.  , 0.  ],
       [0.  , 1.  , 0.  , 0.  , 0.  , 0.  , 0.  , 0.  , 0.  , 0.  ]],
      dtype=float32)
```

In [52]:

```
AccuracyModel1 = model1.evaluate(X_test, y_test)
```

313/313 [==============================] - 1s 2ms/step - loss: 0.5957 - accuracy: 0.7966

## Model2

In [53]:

```
model2 = keras.models.Sequential()
model2.add(keras.layers.Flatten())
model2.add(keras.layers.Flatten(input_shape=[28, 28]))
model2.add(keras.layers.Dense(4, activation='sigmoid'))
model2.add(tf.keras.layers.Dense(10, activation='softmax'))
```

In [54]:

```
model2.compile(loss="sparse_categorical_crossentropy", metrics=["accuracy"], optimizer="
sgd")
history = model2.fit(X_train, y_train, epochs=10, validation_split=0.30)
```

```
Epoch 1/10
1313/1313 [==============================] - 4s 3ms/step - loss: 2.1218 - accuracy: 0.341
5 - val_loss: 1.9255 - val_accuracy: 0.5169
Epoch 2/10
1313/1313 [==============================] - 3s 3ms/step - loss: 1.7516 - accuracy: 0.555
6 - val_loss: 1.5946 - val_accuracy: 0.6030
Epoch 3/10
1313/1313 [==============================] - 4s 3ms/step - loss: 1.4823 - accuracy: 0.610
8 - val_loss: 1.3798 - val_accuracy: 0.6336
Epoch 4/10
1313/1313 [==============================] - 4s 3ms/step - loss: 1.3096 - accuracy: 0.631
8 - val_loss: 1.2411 - val_accuracy: 0.6503
Epoch 5/10
1313/1313 [==============================] - 3s 2ms/step - loss: 1.1950 - accuracy: 0.646
2 - val_loss: 1.1463 - val_accuracy: 0.6588
Epoch 6/10
1313/1313 [==============================] - 3s 2ms/step - loss: 1.1133 - accuracy: 0.657
0 - val_loss: 1.0760 - val_accuracy: 0.6679
Epoch 7/10
1313/1313 [==============================] - 3s 2ms/step - loss: 1.0501 - accuracy: 0.665
```

```
8 - val_loss: 1.0205 - val_accuracy: 0.6803
Epoch 8/10
1313/1313 [==============================] - 4s 3ms/step - loss: 0.9989 - accuracy: 0.683
8 - val_loss: 0.9742 - val_accuracy: 0.6867
Epoch 9/10
1313/1313 [==============================] - 4s 3ms/step - loss: 0.9563 - accuracy: 0.695
9 - val_loss: 0.9362 - val_accuracy: 0.6995
Epoch 10/10
1313/1313 [==============================] - 3s 3ms/step - loss: 0.9201 - accuracy: 0.704
6 - val_loss: 0.9037 - val_accuracy: 0.7075
```

## Model2 Evaluation

In [55]:

```python
model2.evaluate(X_test, y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.9158 - accuracy: 0.7059
```

Out[55]:

```
[0.9157586097717285, 0.7059000134468079]
```

In [56]:

```python
X_new = X_test[:3]
y_proba = model2.predict(X_new)
y_proba.round(2)
```

```
1/1 [==============================] - 0s 66ms/step
```

Out[56]:

```
array([[0.  , 0.02, 0.01, 0.  , 0.01, 0.19, 0.01, 0.08, 0.05, 0.63],
       [0.03, 0.01, 0.31, 0.04, 0.26, 0.02, 0.26, 0.  , 0.06, 0.01],
       [0.01, 0.83, 0.01, 0.09, 0.02, 0.  , 0.01, 0.01, 0.  , 0.03]],
      dtype=float32)
```

In [57]:

```python
AccuracyModel2 = model2.evaluate(X_test, y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.9158 - accuracy: 0.7059
```

## Model3

In [58]:

```python
model3 = keras.models.Sequential()
model3.add(keras.layers.Flatten())
model3.add(keras.layers.Flatten(input_shape=[28, 28]))
model3.add(keras.layers.Dense(100, activation="relu"))
model3.add(keras.layers.Dense(300, activation="relu"))
model3.add(keras.layers.BatchNormalization())
model3.add(keras.layers.Dropout(rate=0.25))
model3.add(keras.layers.Dense(10, activation="softmax"))
```

In [59]:

```python
model3.compile(loss="sparse_categorical_crossentropy", metrics=["accuracy"], optimizer="
sgd")
history = model3.fit(X_train, y_train, epochs=30, validation_split=0.30)
```

```
Epoch 1/30
1313/1313 [==============================] - 8s 5ms/step - loss: 0.6057 - accuracy: 0.787
5 - val_loss: 0.5324 - val_accuracy: 0.8076
Epoch 2/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.4563 - accuracy: 0.838
2 - val_loss: 0.4145 - val_accuracy: 0.8522
Epoch 3/30
```

```
Epoch 3/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.4146 - accuracy: 0.852
6 - val_loss: 0.4252 - val_accuracy: 0.8508
Epoch 4/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.3841 - accuracy: 0.860
7 - val_loss: 0.4045 - val_accuracy: 0.8538
Epoch 5/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.3671 - accuracy: 0.867
5 - val_loss: 0.3715 - val_accuracy: 0.8673
Epoch 6/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.3519 - accuracy: 0.872
2 - val_loss: 0.3513 - val_accuracy: 0.8724
Epoch 7/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.3391 - accuracy: 0.876
7 - val_loss: 0.3559 - val_accuracy: 0.8674
Epoch 8/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.3277 - accuracy: 0.877
3 - val_loss: 0.3781 - val_accuracy: 0.8698
Epoch 9/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.3181 - accuracy: 0.883
7 - val_loss: 0.3391 - val_accuracy: 0.8775
Epoch 10/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.3070 - accuracy: 0.886
2 - val_loss: 0.3351 - val_accuracy: 0.8812
Epoch 11/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.3030 - accuracy: 0.888
6 - val_loss: 0.3691 - val_accuracy: 0.8653
Epoch 12/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2925 - accuracy: 0.892
1 - val_loss: 0.3538 - val_accuracy: 0.8713
Epoch 13/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2887 - accuracy: 0.893
5 - val_loss: 0.3327 - val_accuracy: 0.8814
Epoch 14/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2792 - accuracy: 0.897
1 - val_loss: 0.3274 - val_accuracy: 0.8827
Epoch 15/30
1313/1313 [==============================] - 5s 4ms/step - loss: 0.2721 - accuracy: 0.900
2 - val_loss: 0.3301 - val_accuracy: 0.8811
Epoch 16/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2674 - accuracy: 0.900
9 - val_loss: 0.3272 - val_accuracy: 0.8844
Epoch 17/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2637 - accuracy: 0.903
9 - val_loss: 0.3315 - val_accuracy: 0.8861
Epoch 18/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2584 - accuracy: 0.903
4 - val_loss: 0.3421 - val_accuracy: 0.8790
Epoch 19/30
1313/1313 [==============================] - 5s 4ms/step - loss: 0.2535 - accuracy: 0.908
0 - val_loss: 0.3533 - val_accuracy: 0.8743
Epoch 20/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2465 - accuracy: 0.907
5 - val_loss: 0.3414 - val_accuracy: 0.8806
Epoch 21/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2441 - accuracy: 0.908
2 - val_loss: 0.3263 - val_accuracy: 0.8854
Epoch 22/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2412 - accuracy: 0.908
8 - val_loss: 0.3313 - val_accuracy: 0.8833
Epoch 23/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2368 - accuracy: 0.910
9 - val_loss: 0.3505 - val_accuracy: 0.8741
Epoch 24/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2321 - accuracy: 0.913
9 - val_loss: 0.3507 - val_accuracy: 0.8811
Epoch 25/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2277 - accuracy: 0.916
1 - val_loss: 0.3229 - val_accuracy: 0.8877
Epoch 26/30
1313/1313 [==============================] - 7s 5ms/step - loss: 0.2261 - accuracy: 0.917
0 - val_loss: 0.3478 - val_accuracy: 0.8826
Epoch 27/30
```

```
1313/1313 [==============================] - 5s 4ms/step - loss: 0.2235 - accuracy: 0.916
6 - val_loss: 0.3481 - val_accuracy: 0.8812
Epoch 28/30
1313/1313 [==============================] - 7s 5ms/step - loss: 0.2185 - accuracy: 0.919
0 - val_loss: 0.3258 - val_accuracy: 0.8858
Epoch 29/30
1313/1313 [==============================] - 6s 4ms/step - loss: 0.2115 - accuracy: 0.920
5 - val_loss: 0.3883 - val_accuracy: 0.8784
Epoch 30/30
1313/1313 [==============================] - 6s 5ms/step - loss: 0.2111 - accuracy: 0.922
1 - val_loss: 0.3217 - val_accuracy: 0.8904
```

## Model3 Evaluation

In [60]:

```
model3.evaluate(X_test, y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.3559 - accuracy: 0.8817
```

Out[60]:

```
[0.3559342920780182, 0.8816999793052673]
```

In [61]:

```
X_new = X_test[:3]
y_proba = model3.predict(X_new)
y_proba.round(2)
```

```
1/1 [==============================] - 0s 71ms/step
```

Out[61]:

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

In [62]:

```
AccuracyModel3 = model3.evaluate(X_test, y_test)
```

```
313/313 [==============================] - 1s 2ms/step - loss: 0.3559 - accuracy: 0.8817
```

## Combined model

In [63]:

```
CombinedModel = [model1, model2, model3]
```

In [64]:

```
for model in CombinedModel:
  model.fit(X_test, y_train, epochs=30, validation_split=0.3)
  data = model.evaluate(X_test, y_test)
  print('Combined Model Loss is: {} and Combined Model Accuracy is: {}'.format(data[0],d
ata[1]))
```

```
Epoch 1/30
219/219 [==============================] - 1s 3ms/step - loss: 3.6160 - accuracy: 0.1007
- val_loss: 2.7388 - val_accuracy: 0.0940
Epoch 2/30
219/219 [==============================] - 1s 3ms/step - loss: 2.6146 - accuracy: 0.0993
- val_loss: 2.5313 - val_accuracy: 0.0947
Epoch 3/30
219/219 [==============================] - 1s 2ms/step - loss: 2.4720 - accuracy: 0.0993
- val_loss: 2.4351 - val_accuracy: 0.0950
Epoch 4/30
219/219 [==============================] - 1s 3ms/step - loss: 2.4025 - accuracy: 0.1001
```

```
- val_loss: 2.3842 - val_accuracy: 0.0970
Epoch 5/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3641 - accuracy: 0.1003
- val_loss: 2.3547 - val_accuracy: 0.0970
Epoch 6/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3413 - accuracy: 0.1003
- val_loss: 2.3369 - val_accuracy: 0.0957
Epoch 7/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3273 - accuracy: 0.1006
- val_loss: 2.3259 - val_accuracy: 0.0953
Epoch 8/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3186 - accuracy: 0.1006
- val_loss: 2.3189 - val_accuracy: 0.0957
Epoch 9/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3131 - accuracy: 0.1004
- val_loss: 2.3144 - val_accuracy: 0.0960
Epoch 10/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3094 - accuracy: 0.1003
- val_loss: 2.3114 - val_accuracy: 0.0960
Epoch 11/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3069 - accuracy: 0.1001
- val_loss: 2.3093 - val_accuracy: 0.0957
Epoch 12/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3053 - accuracy: 0.1003
- val_loss: 2.3081 - val_accuracy: 0.0953
Epoch 13/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3042 - accuracy: 0.1003
- val_loss: 2.3072 - val_accuracy: 0.0953
Epoch 14/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3035 - accuracy: 0.0994
- val_loss: 2.3066 - val_accuracy: 0.0953
Epoch 15/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3029 - accuracy: 0.1090
- val_loss: 2.3062 - val_accuracy: 0.0903
Epoch 16/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3025 - accuracy: 0.1084
- val_loss: 2.3060 - val_accuracy: 0.0903
Epoch 17/30
219/219 [==============================] - 0s 2ms/step - loss: 2.3023 - accuracy: 0.1084
- val_loss: 2.3058 - val_accuracy: 0.0900
Epoch 18/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3021 - accuracy: 0.1080
- val_loss: 2.3057 - val_accuracy: 0.0900
Epoch 19/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3019 - accuracy: 0.1086
- val_loss: 2.3056 - val_accuracy: 0.0900
Epoch 20/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3017 - accuracy: 0.1084
- val_loss: 2.3056 - val_accuracy: 0.0900
Epoch 21/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3016 - accuracy: 0.1084
- val_loss: 2.3055 - val_accuracy: 0.0900
Epoch 22/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3015 - accuracy: 0.1086
- val_loss: 2.3056 - val_accuracy: 0.0900
Epoch 23/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3014 - accuracy: 0.1087
- val_loss: 2.3055 - val_accuracy: 0.0900
Epoch 24/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3013 - accuracy: 0.1089
- val_loss: 2.3055 - val_accuracy: 0.0900
Epoch 25/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3012 - accuracy: 0.1089
- val_loss: 2.3056 - val_accuracy: 0.0900
Epoch 26/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3012 - accuracy: 0.1089
- val_loss: 2.3056 - val_accuracy: 0.0900
Epoch 27/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3011 - accuracy: 0.1090
- val_loss: 2.3057 - val_accuracy: 0.0903
Epoch 28/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3010 - accuracy: 0.1089
- val_loss: 2.3056 - val_accuracy: 0.0903
```

```
- val_loss: 2.3056 - val_accuracy: 0.0903
Epoch 29/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3009 - accuracy: 0.1093
- val_loss: 2.3057 - val_accuracy: 0.0903
Epoch 30/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3008 - accuracy: 0.1093
- val_loss: 2.3057 - val_accuracy: 0.0903
313/313 [==============================] - 1s 2ms/step - loss: 2.3021 - accuracy: 0.1016
Combined Model Loss is: 2.3021018505096436 and Combined Model Accuracy is: 0.101599998772
14432
Epoch 1/30
219/219 [==============================] - 1s 3ms/step - loss: 3.5187 - accuracy: 0.0964
- val_loss: 3.2587 - val_accuracy: 0.1003
Epoch 2/30
219/219 [==============================] - 1s 2ms/step - loss: 3.1628 - accuracy: 0.0951
- val_loss: 3.0021 - val_accuracy: 0.1030
Epoch 3/30
219/219 [==============================] - 1s 3ms/step - loss: 2.9230 - accuracy: 0.0954
- val_loss: 2.7897 - val_accuracy: 0.0997
Epoch 4/30
219/219 [==============================] - 1s 2ms/step - loss: 2.7384 - accuracy: 0.0940
- val_loss: 2.6362 - val_accuracy: 0.1037
Epoch 5/30
219/219 [==============================] - 1s 2ms/step - loss: 2.6048 - accuracy: 0.0961
- val_loss: 2.5318 - val_accuracy: 0.0987
Epoch 6/30
219/219 [==============================] - 1s 2ms/step - loss: 2.5053 - accuracy: 0.0986
- val_loss: 2.4576 - val_accuracy: 0.0960
Epoch 7/30
219/219 [==============================] - 1s 2ms/step - loss: 2.4496 - accuracy: 0.1053
- val_loss: 2.4232 - val_accuracy: 0.0983
Epoch 8/30
219/219 [==============================] - 1s 2ms/step - loss: 2.4213 - accuracy: 0.1047
- val_loss: 2.4032 - val_accuracy: 0.1033
Epoch 9/30
219/219 [==============================] - 1s 2ms/step - loss: 2.4044 - accuracy: 0.1024
- val_loss: 2.3915 - val_accuracy: 0.1027
Epoch 10/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3926 - accuracy: 0.1040
- val_loss: 2.3821 - val_accuracy: 0.1027
Epoch 11/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3831 - accuracy: 0.1037
- val_loss: 2.3745 - val_accuracy: 0.1020
Epoch 12/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3756 - accuracy: 0.1026
- val_loss: 2.3680 - val_accuracy: 0.1010
Epoch 13/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3684 - accuracy: 0.1036
- val_loss: 2.3617 - val_accuracy: 0.1010
Epoch 14/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3623 - accuracy: 0.1033
- val_loss: 2.3562 - val_accuracy: 0.0990
Epoch 15/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3563 - accuracy: 0.1029
- val_loss: 2.3505 - val_accuracy: 0.1033
Epoch 16/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3502 - accuracy: 0.1034
- val_loss: 2.3458 - val_accuracy: 0.1030
Epoch 17/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3444 - accuracy: 0.1074
- val_loss: 2.3398 - val_accuracy: 0.0983
Epoch 18/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3386 - accuracy: 0.1031
- val_loss: 2.3346 - val_accuracy: 0.1023
Epoch 19/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3322 - accuracy: 0.1070
- val_loss: 2.3299 - val_accuracy: 0.1000
Epoch 20/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3265 - accuracy: 0.1076
- val_loss: 2.3235 - val_accuracy: 0.0990
Epoch 21/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3202 - accuracy: 0.1040
```

```
- val_loss: 2.3214 - val_accuracy: 0.1020
Epoch 22/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3150 - accuracy: 0.1050
- val_loss: 2.3166 - val_accuracy: 0.1000
Epoch 23/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3110 - accuracy: 0.1036
- val_loss: 2.3143 - val_accuracy: 0.0967
Epoch 24/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3081 - accuracy: 0.1037
- val_loss: 2.3120 - val_accuracy: 0.1000
Epoch 25/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3057 - accuracy: 0.1084
- val_loss: 2.3119 - val_accuracy: 0.0973
Epoch 26/30
219/219 [==============================] - 1s 3ms/step - loss: 2.3042 - accuracy: 0.1081
- val_loss: 2.3110 - val_accuracy: 0.1040
Epoch 27/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3031 - accuracy: 0.1096
- val_loss: 2.3104 - val_accuracy: 0.1037
Epoch 28/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3020 - accuracy: 0.1077
- val_loss: 2.3090 - val_accuracy: 0.0990
Epoch 29/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3016 - accuracy: 0.1081
- val_loss: 2.3117 - val_accuracy: 0.0957
Epoch 30/30
219/219 [==============================] - 1s 2ms/step - loss: 2.3007 - accuracy: 0.1104
- val_loss: 2.3100 - val_accuracy: 0.0997
313/313 [==============================] - 1s 2ms/step - loss: 2.2849 - accuracy: 0.1381
Combined Model Loss is: 2.284923553466797 and Combined Model Accuracy is: 0.1380999982357
0251
Epoch 1/30
219/219 [==============================] - 1s 5ms/step - loss: 2.6494 - accuracy: 0.1017
- val_loss: 2.5109 - val_accuracy: 0.0990
Epoch 2/30
219/219 [==============================] - 1s 6ms/step - loss: 2.3574 - accuracy: 0.1129
- val_loss: 2.3293 - val_accuracy: 0.1040
Epoch 3/30
219/219 [==============================] - 1s 5ms/step - loss: 2.3400 - accuracy: 0.1119
- val_loss: 2.4927 - val_accuracy: 0.1063
Epoch 4/30
219/219 [==============================] - 1s 5ms/step - loss: 2.3248 - accuracy: 0.1171
- val_loss: 2.3242 - val_accuracy: 0.1043
Epoch 5/30
219/219 [==============================] - 1s 5ms/step - loss: 2.3131 - accuracy: 0.1211
- val_loss: 2.3283 - val_accuracy: 0.1103
Epoch 6/30
219/219 [==============================] - 1s 5ms/step - loss: 2.3146 - accuracy: 0.1170
- val_loss: 2.3254 - val_accuracy: 0.0953
Epoch 7/30
219/219 [==============================] - 1s 4ms/step - loss: 2.3054 - accuracy: 0.1243
- val_loss: 2.3245 - val_accuracy: 0.0957
Epoch 8/30
219/219 [==============================] - 1s 5ms/step - loss: 2.3003 - accuracy: 0.1237
- val_loss: 2.3321 - val_accuracy: 0.1050
Epoch 9/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2976 - accuracy: 0.1207
- val_loss: 2.3365 - val_accuracy: 0.0977
Epoch 10/30
219/219 [==============================] - 1s 4ms/step - loss: 2.2933 - accuracy: 0.1324
- val_loss: 2.3331 - val_accuracy: 0.0977
Epoch 11/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2826 - accuracy: 0.1313
- val_loss: 2.3625 - val_accuracy: 0.1013
Epoch 12/30
219/219 [==============================] - 1s 4ms/step - loss: 2.2895 - accuracy: 0.1284
- val_loss: 2.3420 - val_accuracy: 0.0997
Epoch 13/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2848 - accuracy: 0.1361
- val_loss: 2.3329 - val_accuracy: 0.1010
Epoch 14/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2768 - accuracy: 0.1393
```

```
- val_loss: 2.3308 - val_accuracy: 0.1097
Epoch 15/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2734 - accuracy: 0.1361
- val_loss: 2.3534 - val_accuracy: 0.1063
Epoch 16/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2675 - accuracy: 0.1426
- val_loss: 2.3589 - val_accuracy: 0.1090
Epoch 17/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2644 - accuracy: 0.1439
- val_loss: 2.3444 - val_accuracy: 0.1023
Epoch 18/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2617 - accuracy: 0.1477
- val_loss: 2.3487 - val_accuracy: 0.1013
Epoch 19/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2593 - accuracy: 0.1490
- val_loss: 2.3534 - val_accuracy: 0.0977
Epoch 20/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2590 - accuracy: 0.1509
- val_loss: 2.3490 - val_accuracy: 0.1060
Epoch 21/30
219/219 [==============================] - 1s 6ms/step - loss: 2.2520 - accuracy: 0.1541
- val_loss: 2.3581 - val_accuracy: 0.0980
Epoch 22/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2483 - accuracy: 0.1531
- val_loss: 2.3638 - val_accuracy: 0.0993
Epoch 23/30
219/219 [==============================] - 1s 4ms/step - loss: 2.2375 - accuracy: 0.1593
- val_loss: 2.3520 - val_accuracy: 0.1050
Epoch 24/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2315 - accuracy: 0.1666
- val_loss: 2.3549 - val_accuracy: 0.1087
Epoch 25/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2270 - accuracy: 0.1643
- val_loss: 2.3625 - val_accuracy: 0.1080
Epoch 26/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2228 - accuracy: 0.1676
- val_loss: 2.4053 - val_accuracy: 0.1057
Epoch 27/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2212 - accuracy: 0.1744
- val_loss: 2.3654 - val_accuracy: 0.1130
Epoch 28/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2092 - accuracy: 0.1764
- val_loss: 2.3818 - val_accuracy: 0.1053
Epoch 29/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2056 - accuracy: 0.1763
- val_loss: 2.3940 - val_accuracy: 0.1053
Epoch 30/30
219/219 [==============================] - 1s 5ms/step - loss: 2.2059 - accuracy: 0.1813
- val_loss: 2.3791 - val_accuracy: 0.1103
313/313 [==============================] - 1s 3ms/step - loss: 2.3200 - accuracy: 0.1424
Combined Model Loss is: 2.320042133331299 and Combined Model Accuracy is: 0.1423999965190
8875
```

In [65]:

```
AvgAllModels = (AccuracyModel1[1] + AccuracyModel2[1] + AccuracyModel3[1])/3
```

## Avg of all the 3 models

In [66]:

```
AvgAllModels
```

Out[66]:

```
0.7947333256403605
```