```
import os
import shutil
os.environ['KAGGLE_CONFIG_DIR']='/content'
```

link_to_dataset [link]

Downloading the dataset through kaggle API

```
!kaggle datasets download -d jonathanoheix/face-expression-recognition-dataset
```

```
Warning: Your Kaggle API key is readable by other users on this system! To fix this, you
Downloading face-expression-recognition-dataset.zip to /content
 94% 113M/121M [00:01<00:00, 94.4MB/s]
100% 121M/121M [00:01<00:00, 113MB/s]
```

Unziping the downloaded zip file

```
!unzip "/content/face-expression-recognition-dataset.zip" -d "/content"
```

```
Streaming output truncated to the last 5000 lines.
  inflating: /content/images/validation/fear/8797.jpg
  inflating: /content/images/validation/fear/8818.jpg
  inflating: /content/images/validation/fear/886.jpg
  inflating: /content/images/validation/fear/9037.jpg
  inflating: /content/images/validation/fear/9040.jpg
  inflating: /content/images/validation/fear/9101.jpg
  inflating: /content/images/validation/fear/911.jpg
  inflating: /content/images/validation/fear/9179.jpg
  inflating: /content/images/validation/fear/9205.jpg
  inflating: /content/images/validation/fear/9232.jpg
  inflating: /content/images/validation/fear/9251.jpg
  inflating: /content/images/validation/fear/9261.jpg
  inflating: /content/images/validation/fear/9281.jpg
  inflating: /content/images/validation/fear/9302.jpg
  inflating: /content/images/validation/fear/9333.jpg
  inflating: /content/images/validation/fear/9369.jpg
  inflating: /content/images/validation/fear/9370.jpg
  inflating: /content/images/validation/fear/9474.jpg
  inflating: /content/images/validation/fear/949.jpg
  inflating: /content/images/validation/fear/9602.jpg
  inflating: /content/images/validation/fear/9606.jpg
  inflating: /content/images/validation/fear/9842.jpg
  inflating: /content/images/validation/fear/9898.jpg
  inflating: /content/images/validation/happy/10019.jpg
  inflating: /content/images/validation/happy/10023.jpg
```

```
inflating: /content/images/validation/happy/10074.jpg
inflating: /content/images/validation/happy/10096.jpg
inflating: /content/images/validation/happy/10106.jpg
inflating: /content/images/validation/happy/10126.jpg
inflating: /content/images/validation/happy/10138.jpg
inflating: /content/images/validation/happy/10141.jpg
inflating: /content/images/validation/happy/1020.jpg
inflating: /content/images/validation/happy/10218.jpg
inflating: /content/images/validation/happy/10237.jpg
inflating: /content/images/validation/happy/10248.jpg
inflating: /content/images/validation/happy/10257.jpg
inflating: /content/images/validation/happy/1027.jpg
inflating: /content/images/validation/happy/10273.jpg
inflating: /content/images/validation/happy/10276.jpg
inflating: /content/images/validation/happy/10312.jpg
inflating: /content/images/validation/happy/10317.jpg
inflating: /content/images/validation/happy/10344.jpg
inflating: /content/images/validation/happy/10362.jpg
inflating: /content/images/validation/happy/10367.jpg
inflating: /content/images/validation/happy/10370.jpg
inflating: /content/images/validation/happy/10432.jpg
inflating: /content/images/validation/happy/10456.jpg
inflating: /content/images/validation/happy/10467.jpg
inflating: /content/images/validation/happy/10468.jpg
inflating: /content/images/validation/happy/10480.jpg
inflating: /content/images/validation/happy/10528.jpg
inflating: /content/images/validation/happy/10540.jpg
inflating: /content/images/validation/happy/10552.jpg
inflating: /content/images/validation/happy/1056.jpg
inflating: /content/images/validation/happy/10571.jpg
inflating: /content/images/validation/happy/1058.jpg
inflating: /content/images/validation/happy/10622.jpg
inflating: /content/images/validation/happy/10638.jpg
```

We got 7 different classes of emotion dataset. As part of our case study we require only 4 classes

Here we are coping the required classes of images into another folder

```
classes = ["angry","happy","neutral","sad"]

for emotion in classes:
  src1 = "/content/images/train/"+str(emotion)
  dest1 = "/content/dataset/train/"+str(emotion)
  src2 = "/content/images/validation/"+str(emotion)
  dest2 = "/content/dataset/test/"+str(emotion)
  shutil.copytree(src1, dest1)
```

```
  shutil.copytree(src2, dest2)
  print("{} emotion images copied".format(emotion))
```

```
angry emotion images copied
happy emotion images copied
neutral emotion images copied
sad emotion images copied
```

Importing the required pakages

```
from tensorflow.keras.applications import VGG16
from tensorflow.keras.layers import Conv2D, MaxPool2D
from tensorflow.keras.layers import Activation, Dropout, Flatten, Dense,Input
from tensorflow.keras.models import Model
from keras.preprocessing.image import load_img, img_to_array
from keras.preprocessing.image import ImageDataGenerator
#from tensorflow import keras
import matplotlib.pyplot as plt
import tensorflow as tf
import os
import numpy as np
import datetime
%load_ext tensorboard


tf.keras.backend.clear_session()
```

Our datset is having image size 48X48.Hence we picked image size as 48.

```
targetsize = 48
folder_path = "/content/dataset/"
```

Ploting the some of the images

```
expression = 'angry'

plt.figure(figsize= (12,12))
for i in range(1, 10, 1):
    plt.subplot(3,3,i)
    img = load_img(folder_path+"train/"+expression+"/"+
```

```
                    os.listdir(folder_path + "train/" + expression)[i], target_size=(targetsize
    plt.imshow(img)
plt.show()
```

Here we are reading the data from the directory by using Image dat generator and flow from directory

```
batch_size  = 64
```

```
datagen_train = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

datagen_val = ImageDataGenerator(rescale = 1./255)


training_set = datagen_train.flow_from_directory(folder_path+"train",
                                                 target_size = (targetsize,targetsize),
                                                 batch_size=batch_size,
                                                 class_mode='categorical',
                                                 shuffle=True)


test_set = datagen_val.flow_from_directory(folder_path+"test",
                                                 target_size = (targetsize,targetsize),
                                                 batch_size=batch_size,
                                                 class_mode='categorical',
                                                 shuffle=False)
```

```
Found 21077 images belonging to 4 classes.
Found 5140 images belonging to 4 classes.
```

Model 1

```
vgg = VGG16(include_top=False, weights='imagenet')
vgg.trainable = False
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16
58892288/58889256 [==============================] - 1s 0us/step
58900480/58889256 [==============================] - 1s 0us/step
```

```
input_layer = Input(shape=(targetsize,targetsize,3,))
vgg_layer = vgg(input_layer)
layer1 = Conv2D(filters=256,kernel_size=(3,3),strides=(1,1),padding="same",activation='relu',
                    kernel_initializer=tf.keras.initializers.he_normal(seed=20))(vgg_layer)
layer2 = MaxPool2D(pool_size=(2, 2), strides=(1,1), padding="same")(layer1)
flatten_layer = Flatten()(layer2)
layer3 = Dense(128,activation='relu',kernel_initializer=tf.keras.initializers.he_normal(seed=
layer4 = Dense(64,activation='relu',kernel_initializer=tf.keras.initializers.he_normal(seed=2
output = Dense(4,activation='softmax',kernel_initializer=tf.keras.initializers.GlorotNormal(s
model_1 = Model(inputs=input_layer,outputs=output)
model_1.summary()
```

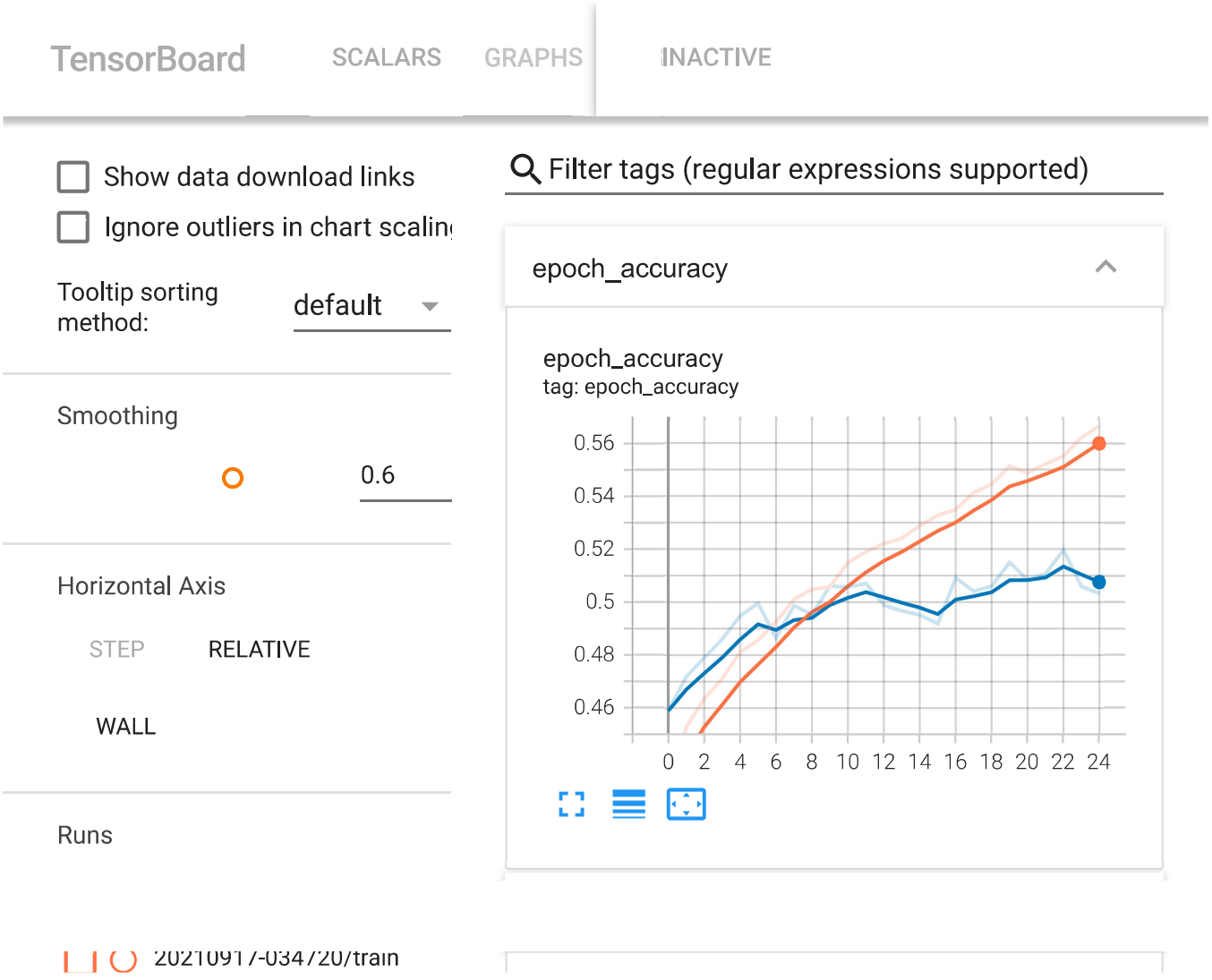
```
Model: "model"
_________________________________________________________________
```

```
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         [(None, 48, 48, 3)]       0
_________________________________________________________________
vgg16 (Functional)           (None, None, None, 512)   14714688
_________________________________________________________________
conv2d (Conv2D)              (None, 1, 1, 256)         1179904
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 1, 1, 256)         0
_________________________________________________________________
flatten (Flatten)            (None, 256)               0
_________________________________________________________________
dense (Dense)                (None, 128)               32896
_________________________________________________________________
dense_1 (Dense)              (None, 64)                8256
_________________________________________________________________
dense_2 (Dense)              (None, 4)                 260
=================================================================
Total params: 15,936,004
Trainable params: 1,221,316
Non-trainable params: 14,714,688
_________________________________________________________________
```

```
# Clear any logs from previous runs
!rm -rf ./logs1/


model_1.compile(optimizer=tf.keras.optimizers.Adam(learning_rate=0.001),loss='categorical_cro

log_dir=os.path.join("logs1",datetime.datetime.now().strftime("%Y%m%d-%H%M%S"))
tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir=log_dir,histogram_freq=1, write

model_1.fit_generator(training_set,validation_data=test_set,epochs=25,steps_per_epoch=len(tra

WARNING:tensorflow:`write_grads` will be ignored in TensorFlow 2.0 for the `TensorBoard`
/usr/local/lib/python3.7/dist-packages/keras/engine/training.py:1972: UserWarning: `Mode
  warnings.warn('`Model.fit_generator` is deprecated and '
Epoch 1/25
330/330 [==============================] - 67s 117ms/step - loss: 1.2775 - accuracy: 0.4
Epoch 2/25
330/330 [==============================] - 37s 111ms/step - loss: 1.2320 - accuracy: 0.4
Epoch 3/25
330/330 [==============================] - 36s 109ms/step - loss: 1.2125 - accuracy: 0.4
Epoch 4/25
330/330 [==============================] - 36s 108ms/step - loss: 1.1998 - accuracy: 0.4
Epoch 5/25
330/330 [==============================] - 35s 107ms/step - loss: 1.1863 - accuracy: 0.4
Epoch 6/25
330/330 [==============================] - 37s 112ms/step - loss: 1.1759 - accuracy: 0.4
Epoch 7/25
330/330 [==============================] - 37s 111ms/step - loss: 1.1647 - accuracy: 0.4
Epoch 8/25
330/330 [==============================] - 36s 108ms/step - loss: 1.1543 - accuracy: 0.5
Epoch 9/25
330/330 [==============================] - 35s 105ms/step - loss: 1.1437 - accuracy: 0.5
```

```
Epoch 10/25
330/330 [==============================] - 36s 111ms/step - loss: 1.1361 - accuracy: 0.5
Epoch 11/25
330/330 [==============================] - 36s 109ms/step - loss: 1.1312 - accuracy: 0.5
Epoch 12/25
330/330 [==============================] - 36s 108ms/step - loss: 1.1191 - accuracy: 0.5
Epoch 13/25
330/330 [==============================] - 37s 112ms/step - loss: 1.1105 - accuracy: 0.5
Epoch 14/25
330/330 [==============================] - 37s 111ms/step - loss: 1.1048 - accuracy: 0.5
Epoch 15/25
330/330 [==============================] - 36s 110ms/step - loss: 1.0974 - accuracy: 0.5
Epoch 16/25
330/330 [==============================] - 36s 109ms/step - loss: 1.0916 - accuracy: 0.5
Epoch 17/25
330/330 [==============================] - 35s 107ms/step - loss: 1.0858 - accuracy: 0.5
Epoch 18/25
330/330 [==============================] - 37s 112ms/step - loss: 1.0758 - accuracy: 0.5
Epoch 19/25
330/330 [==============================] - 37s 111ms/step - loss: 1.0669 - accuracy: 0.5
Epoch 20/25
330/330 [==============================] - 36s 109ms/step - loss: 1.0599 - accuracy: 0.5
Epoch 21/25
330/330 [==============================] - 36s 108ms/step - loss: 1.0584 - accuracy: 0.5
Epoch 22/25
330/330 [==============================] - 35s 106ms/step - loss: 1.0505 - accuracy: 0.5
Epoch 23/25
330/330 [==============================] - 35s 105ms/step - loss: 1.0452 - accuracy: 0.5
Epoch 24/25
330/330 [==============================] - 36s 110ms/step - loss: 1.0329 - accuracy: 0.5
Epoch 25/25
330/330 [==============================] - 36s 108ms/step - loss: 1.0230 - accuracy: 0.5
<keras.callbacks.History at 0x7f98e031b3d0>
```

```
%tensorboard --logdir logs1/
```



Model 2

```
batch_size  = 64

datagen_train = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

datagen_val = ImageDataGenerator(rescale = 1./255)

training_set = datagen_train.flow_from_directory(folder_path+"train",
                                                 target_size = (96,96),
                                                 batch_size=batch_size,
```

```
                                                class_mode='categorical',
                                                shuffle=True)


test_set = datagen_val.flow_from_directory(folder_path+"test",
                                                target_size = (96,96),
                                                batch_size=batch_size,
                                                class_mode='categorical',
                                                shuffle=False)
```

```
Found 21077 images belonging to 4 classes.
Found 5140 images belonging to 4 classes.
```

```
classes = ["angry","happy","neutral","sad"]


from tensorflow.keras.applications.inception_v3 import InceptionV3

inception = InceptionV3(input_shape=(96,96,3), weights='imagenet', include_top=False)
# don't train existing weights
for layer in inception.layers:
    layer.trainable = False

flatten = Flatten(data_format='channels_last',name='Flatten')(inception.output)

Out = Dense(units=len(classes),activation='softmax',kernel_initializer=tf.keras.initializers.

model2 = Model(inputs=inception.input, outputs=Out)
model2.summary()
```

```
batch_normalization_359 (BatchN (None, 1, 1, 384)    1152        conv2d_359[0][0]
__________________________________________________________________________________________________
batch_normalization_363 (BatchN (None, 1, 1, 384)    1152        conv2d_363[0][0]
__________________________________________________________________________________________________
activation_359 (Activation)     (None, 1, 1, 384)    0           batch_normalization_
__________________________________________________________________________________________________
activation_363 (Activation)     (None, 1, 1, 384)    0           batch_normalization_
__________________________________________________________________________________________________
conv2d_360 (Conv2D)             (None, 1, 1, 384)    442368      activation_359[0][0]
__________________________________________________________________________________________________
conv2d_361 (Conv2D)             (None, 1, 1, 384)    442368      activation_359[0][0]
__________________________________________________________________________________________________
conv2d_364 (Conv2D)             (None, 1, 1, 384)    442368      activation_363[0][0]
__________________________________________________________________________________________________
conv2d_365 (Conv2D)             (None, 1, 1, 384)    442368      activation_363[0][0]
__________________________________________________________________________________________________
average_pooling2d_34 (AveragePo (None, 1, 1, 1280)   0           mixed8[0][0]
__________________________________________________________________________________________________
conv2d_358 (Conv2D)             (None, 1, 1, 320)    409600      mixed8[0][0]
__________________________________________________________________________________________________
batch_normalization_360 (BatchN (None, 1, 1, 384)    1152        conv2d_360[0][0]
__________________________________________________________________________________________________
batch_normalization_361 (BatchN (None, 1, 1, 384)    1152        conv2d_361[0][0]
__________________________________________________________________________________________________
batch_normalization_364 (BatchN (None, 1, 1, 384)    1152        conv2d_364[0][0]
```

batch_normalization_364 (BatchN	(None, 1, 1, 384)	1152	conv2d_364[0][0]
batch_normalization_365 (BatchN	(None, 1, 1, 384)	1152	conv2d_365[0][0]
conv2d_366 (Conv2D)	(None, 1, 1, 192)	245760	average_pooling2d_34
batch_normalization_358 (BatchN	(None, 1, 1, 320)	960	conv2d_358[0][0]
activation_360 (Activation)	(None, 1, 1, 384)	0	batch_normalization_
activation_361 (Activation)	(None, 1, 1, 384)	0	batch_normalization_
activation_364 (Activation)	(None, 1, 1, 384)	0	batch_normalization_
activation_365 (Activation)	(None, 1, 1, 384)	0	batch_normalization_
batch_normalization_366 (BatchN	(None, 1, 1, 192)	576	conv2d_366[0][0]
activation_358 (Activation)	(None, 1, 1, 320)	0	batch_normalization_
mixed9_0 (Concatenate)	(None, 1, 1, 768)	0	activation_360[0][0] activation_361[0][0]
concatenate_6 (Concatenate)	(None, 1, 1, 768)	0	activation_364[0][0] activation_365[0][0]
activation_366 (Activation)	(None, 1, 1, 192)	0	batch_normalization_
mixed9 (Concatenate)	(None, 1, 1, 2048)	0	activation_358[0][0] mixed9_0[0][0] concatenate_6[0][0] activation_366[0][0]
conv2d_371 (Conv2D)	(None, 1, 1, 448)	917504	mixed9[0][0]

```
# Clear any logs from previous runs
!rm -rf ./logs2/
```

```
model2.compile(optimizer=tf.keras.optimizers.Adam(lr=0.001),loss='categorical_crossentropy',m
```

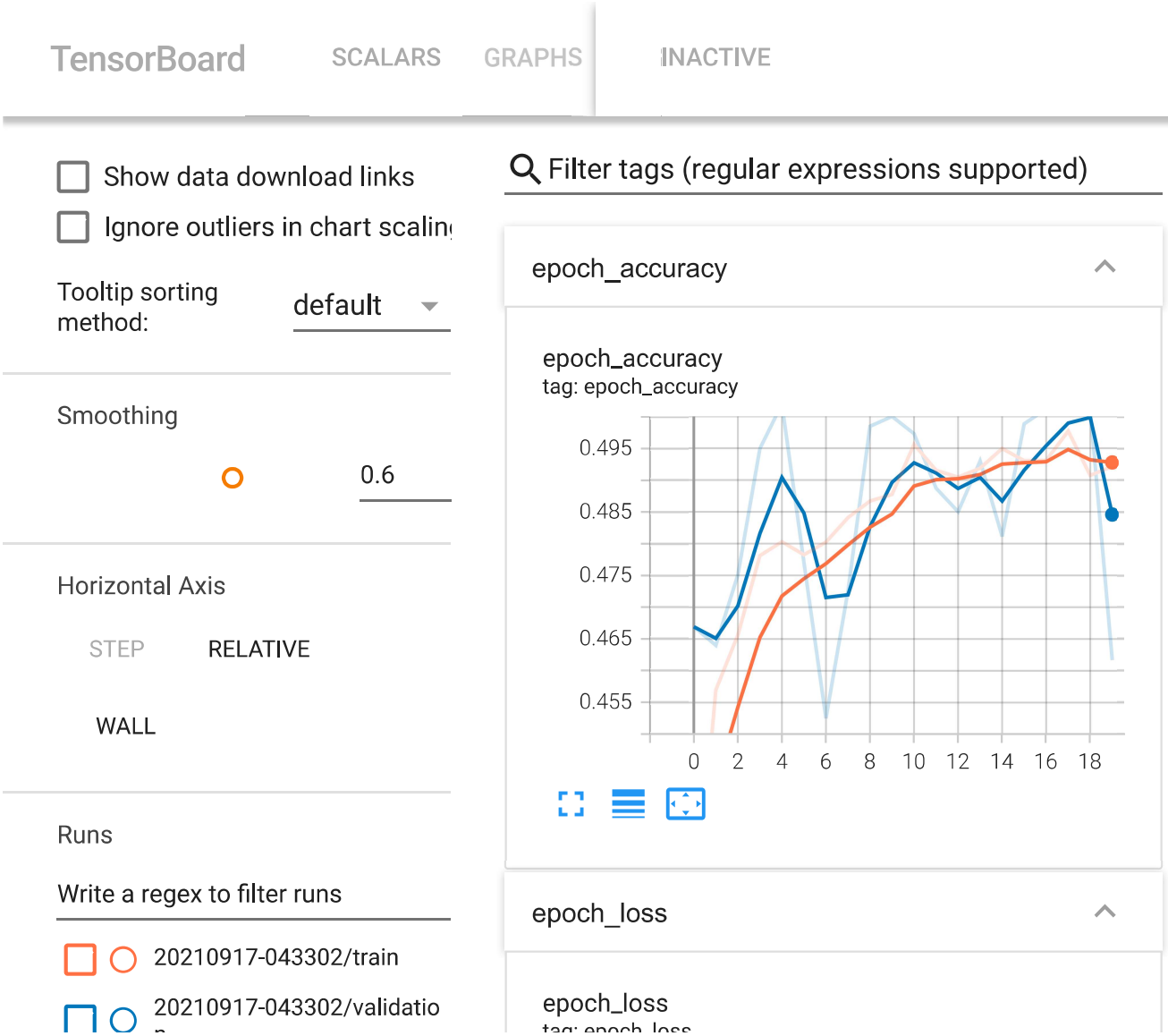
```
log_dir=os.path.join("logs2",datetime.datetime.now().strftime("%Y%m%d-%H%M%S"))
tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir=log_dir,histogram_freq=1, write
```

```
result = model2.fit_generator(training_set,validation_data=test_set,epochs=20,steps_per_epoch
```

```
/usr/local/lib/python3.7/dist-packages/keras/optimizer_v2/optimizer_v2.py:356: UserWarni
  "The `lr` argument is deprecated, use `learning_rate` instead.")
WARNING:tensorflow:`write_grads` will be ignored in TensorFlow 2.0 for the `TensorBoard`
/usr/local/lib/python3.7/dist-packages/keras/engine/training.py:1972: UserWarning: `Mode
  warnings.warn('`Model.fit_generator` is deprecated and '
Epoch 1/20
330/330 [==============================] - 83s 231ms/step - loss: 1.3134 - accuracy: 0.4
```

```
Epoch 2/20
330/330 [==============================] - 78s 237ms/step - loss: 1.2416 - accuracy: 0.4
Epoch 3/20
330/330 [==============================] - 75s 226ms/step - loss: 1.2212 - accuracy: 0.4
Epoch 4/20
330/330 [==============================] - 74s 224ms/step - loss: 1.2004 - accuracy: 0.4
Epoch 5/20
330/330 [==============================] - 73s 221ms/step - loss: 1.1934 - accuracy: 0.4
Epoch 6/20
330/330 [==============================] - 73s 221ms/step - loss: 1.1990 - accuracy: 0.4
Epoch 7/20
330/330 [==============================] - 74s 224ms/step - loss: 1.2044 - accuracy: 0.4
Epoch 8/20
330/330 [==============================] - 74s 224ms/step - loss: 1.1904 - accuracy: 0.4
Epoch 9/20
330/330 [==============================] - 72s 219ms/step - loss: 1.1810 - accuracy: 0.4
Epoch 10/20
330/330 [==============================] - 73s 222ms/step - loss: 1.1825 - accuracy: 0.4
Epoch 11/20
330/330 [==============================] - 72s 218ms/step - loss: 1.1755 - accuracy: 0.4
Epoch 12/20
330/330 [==============================] - 73s 221ms/step - loss: 1.1834 - accuracy: 0.4
Epoch 13/20
330/330 [==============================] - 72s 218ms/step - loss: 1.1833 - accuracy: 0.4
Epoch 14/20
330/330 [==============================] - 73s 222ms/step - loss: 1.1750 - accuracy: 0.4
Epoch 15/20
330/330 [==============================] - 73s 222ms/step - loss: 1.1760 - accuracy: 0.4
Epoch 16/20
330/330 [==============================] - 72s 219ms/step - loss: 1.1734 - accuracy: 0.4
Epoch 17/20
330/330 [==============================] - 73s 220ms/step - loss: 1.1772 - accuracy: 0.4
Epoch 18/20
330/330 [==============================] - 72s 218ms/step - loss: 1.1740 - accuracy: 0.4
Epoch 19/20
330/330 [==============================] - 72s 218ms/step - loss: 1.1812 - accuracy: 0.4
Epoch 20/20
330/330 [==============================] - 72s 220ms/step - loss: 1.1735 - accuracy: 0.4
```

```
%tensorboard --logdir logs2/
```



Model 3

```
batch_size  = 64

datagen_train = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

datagen_val = ImageDataGenerator(rescale = 1./255)
```

```
training_set = datagen_train.flow_from_directory(folder_path+"train",
                                                 target_size = (targetsize,targetsize),
                                                 batch_size=batch_size,
                                                 class_mode='categorical',
                                                 shuffle=True)


test_set = datagen_val.flow_from_directory(folder_path+"test",
                                                 target_size = (targetsize,targetsize),
                                                 batch_size=batch_size,
                                                 class_mode='categorical',
                                                 shuffle=False)
```

```
Found 21077 images belonging to 4 classes.
Found 5140 images belonging to 4 classes.
```

```
vgg = VGG16(include_top=False, weights='imagenet',input_shape=(48,48,3))
for layer in vgg.layers[:-6]:
  layer.trainable = False
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/vgg16
58892288/58889256 [==============================] - 1s 0us/step
58900480/58889256 [==============================] - 1s 0us/step
```

```
input_layer = Input(shape=(48,48,3,))
vgg_layer = vgg(input_layer)
layer1 = Conv2D(filters=1024,kernel_size=(7,7),strides=(1,1),padding="same",activation='relu'
                    kernel_initializer='he_normal')(vgg_layer)
layer2 = Conv2D(filters=1024,kernel_size=(1,1),strides=(1,1),padding="same",activation='relu'
                    kernel_initializer='he_normal')(layer1)
flatten_layer = Flatten()(layer2)
layer3 = Dense(128,activation='relu',kernel_initializer=tf.keras.initializers.he_normal(seed=
layer4 = Dense(64,activation='relu',kernel_initializer=tf.keras.initializers.he_normal(seed=2
output = Dense(4,activation='softmax',kernel_initializer=tf.keras.initializers.GlorotNormal(s
model_3 = Model(inputs=input_layer,outputs=output)
model_3.summary()
```

```
Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         [(None, 48, 48, 3)]       0
_________________________________________________________________
vgg16 (Functional)           (None, 1, 1, 512)         14714688
_________________________________________________________________
conv2d (Conv2D)              (None, 1, 1, 1024)        25691136
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 1, 1, 1024)        1049600
_________________________________________________________________
flatten (Flatten)            (None, 1024)              0
```

```
dense (Dense)                (None, 128)               131200
_________________________________________________________________
dense_1 (Dense)              (None, 64)                8256
_________________________________________________________________
dense_2 (Dense)              (None, 4)                 260
=================================================================
Total params: 41,595,140
Trainable params: 36,319,684
Non-trainable params: 5,275,456
_________________________________________________________________
```

```
!rm -rf ./logs3/
```

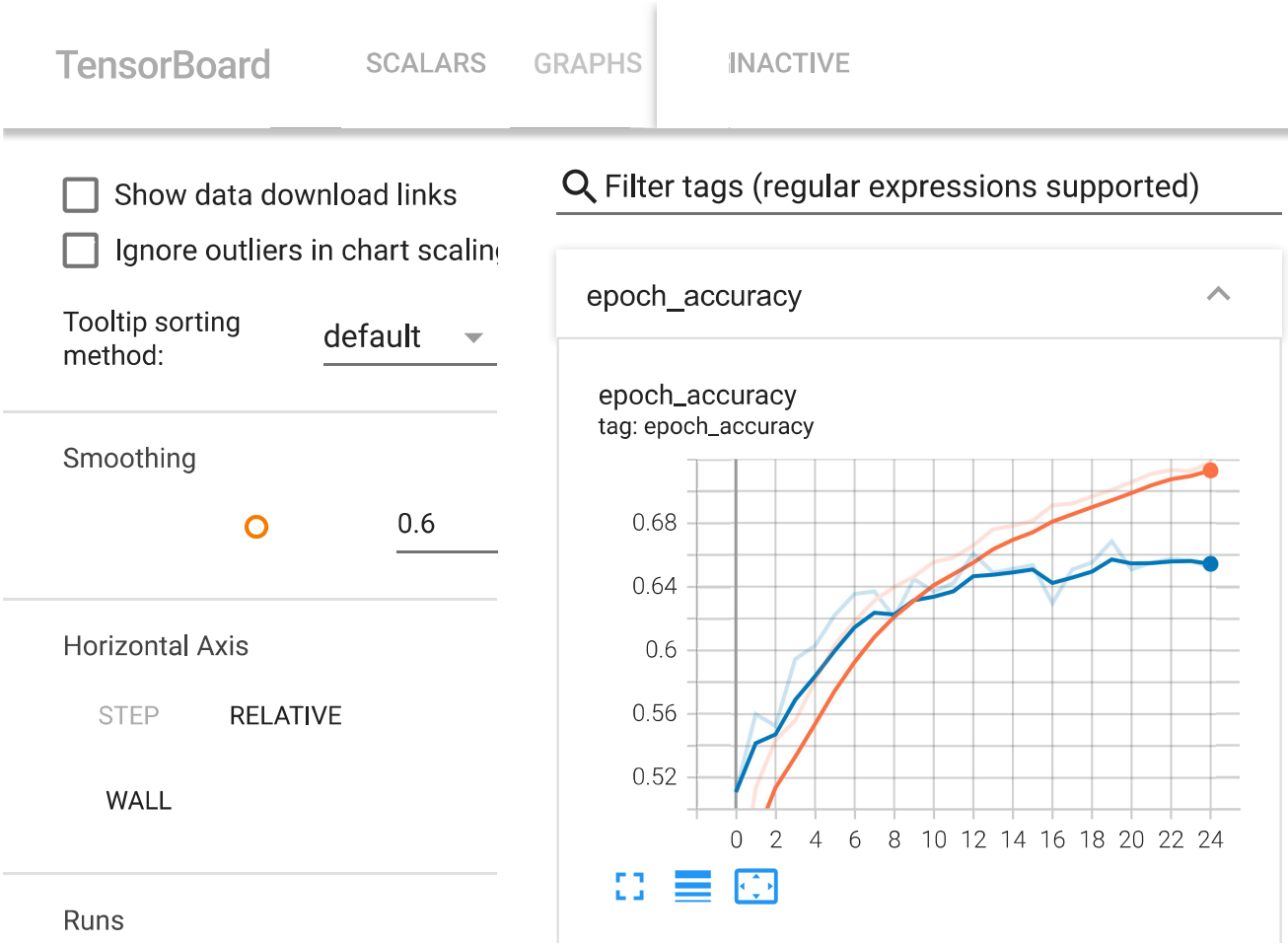
```
from keras.callbacks import ModelCheckpoint, EarlyStopping

filepath="/content/model_save/weights-{epoch:02d}-{val_accuracy:.4f}.hdf5"

checkpoint = ModelCheckpoint(filepath=filepath, monitor='val_loss',  verbose=1, save_best_onl
```

```
model_3.compile(optimizer=tf.keras.optimizers.Adam(learning_rate=0.001),loss='categorical_cro

log_dir=os.path.join("logs3",datetime.datetime.now().strftime("%Y%m%d-%H%M%S"))
tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir=log_dir,histogram_freq=1, write

model_3.fit_generator(training_set,validation_data=test_set,epochs=25,steps_per_epoch=len(tra
```

```
Epoch 12/25
330/330 [==============================] - 45s 137ms/step - loss: 0.8476 - accuracy:

Epoch 00012: saving model to /content/model_save/weights-12-0.6422.hdf5
Epoch 13/25
330/330 [==============================] - 46s 139ms/step - loss: 0.8205 - accuracy:

Epoch 00013: saving model to /content/model_save/weights-13-0.6607.hdf5
Epoch 14/25
330/330 [==============================] - 45s 137ms/step - loss: 0.8051 - accuracy:

Epoch 00014: saving model to /content/model_save/weights-14-0.6488.hdf5
Epoch 15/25
330/330 [==============================] - 45s 137ms/step - loss: 0.7944 - accuracy:

Epoch 00015: saving model to /content/model_save/weights-15-0.6512.hdf5
Epoch 16/25
330/330 [==============================] - 45s 137ms/step - loss: 0.7916 - accuracy:

Epoch 00016: saving model to /content/model_save/weights-16-0.6535.hdf5
Epoch 17/25
330/330 [==============================] - 46s 138ms/step - loss: 0.7736 - accuracy:

Epoch 00017: saving model to /content/model_save/weights-17-0.6296.hdf5
Epoch 18/25
```

```
330/330 [==============================] - 45s 136ms/step - loss: 0.7697 - accuracy:

Epoch 00018: saving model to /content/model_save/weights-18-0.6508.hdf5
Epoch 19/25
330/330 [==============================] - 46s 138ms/step - loss: 0.7587 - accuracy:

Epoch 00019: saving model to /content/model_save/weights-19-0.6551.hdf5
Epoch 20/25
330/330 [==============================] - 45s 136ms/step - loss: 0.7473 - accuracy:


Epoch 00020: saving model to /content/model_save/weights-20-0.6685.hdf5
Epoch 21/25
330/330 [==============================] - 45s 136ms/step - loss: 0.7425 - accuracy:

Epoch 00021: saving model to /content/model_save/weights-21-0.6508.hdf5
Epoch 22/25
330/330 [==============================] - 45s 136ms/step - loss: 0.7287 - accuracy:

Epoch 00022: saving model to /content/model_save/weights-22-0.6551.hdf5
Epoch 23/25
330/330 [==============================] - 45s 136ms/step - loss: 0.7260 - accuracy:

Epoch 00023: saving model to /content/model_save/weights-23-0.6574.hdf5
Epoch 24/25
330/330 [==============================] - 45s 136ms/step - loss: 0.7217 - accuracy:

Epoch 00024: saving model to /content/model_save/weights-24-0.6564.hdf5
Epoch 25/25
330/330 [==============================] - 45s 136ms/step - loss: 0.7059 - accuracy:

Epoch 00025: saving model to /content/model_save/weights-25-0.6518.hdf5
<keras.callbacks.History at 0x7f91b3eead50>
```

```
%tensorboard --logdir logs3/
```




```
model_3.load_weights('/content/model_save/weights-20-0.6685.hdf5')
```

```
model_3.save('/content/saved_model/face_emotion.h5')
```