Import Dependencies

In [10]:
```
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Model, Sequential, load_model
from tensorflow.keras.layers import Input, Dense, Activation, Flatten, Conv2D, MaxPool2D
from tensorflow.keras.optimizers import Adam
from sklearn.metrics import classification_report, confusion_matrix, ConfusionMatrixDisp

from keras.callbacks import EarlyStopping, ModelCheckpoint
import matplotlib.pyplot as plt
import numpy as np
```

Check if Tensorflow is Using GPU

In [2]:
```
import tensorflow as tf
tf.config.list_physical_devices('GPU')
```

Out[2]:
```
[PhysicalDevice(name='/physical_device:GPU:0', device_type='GPU')]
```

In [3]:
```
EPOCHS = 100
Batch_size = 32

train_loc = "Data/train/"
test_loc ="Data/test/"
val_loc = "Data/valid/"
```

Data Agumention

In [4]:
```
trdata = ImageDataGenerator(rescale=1./255,
                            shear_range=0.2,
                            zoom_range=0.2,
                            rotation_range=0.2,
                            height_shift_range=0.2,
                            width_shift_range=0.2,
                            horizontal_flip=True,
                            fill_mode="nearest",
                           )
traindata = trdata.flow_from_directory(
    directory=train_loc, target_size=(224,224), shuffle=True)
tsdata = ImageDataGenerator(rescale=1./255)
testdata = tsdata.flow_from_directory(
    directory=test_loc, target_size=(224,224), shuffle=False)
vdata = ImageDataGenerator(rescale=1./255)
valdata = vdata.flow_from_directory(
    directory=val_loc, target_size=(224,224), shuffle=True)

traindata.class_indices
```

```
Found 2339 images belonging to 10 classes.
Found 50 images belonging to 10 classes.
Found 50 images belonging to 10 classes.
```

Out[4]:
```
{'AFRICAN LEOPARD': 0,
 'CARACAL': 1,
 'CHEETAH': 2,
 'CLOUDED LEOPARD': 3,
 'JAGUAR': 4,
 'LIONS': 5,
 'OCELOT': 6,
 'PUMA': 7,
 'SNOW LEOPARD': 8,
 'TIGER': 9}
```

Build the Model

In [5]:
```
input_shape = (224,224, 3)
img_input = Input(shape=input_shape, name='ey-image-input')

# Build the model
x = Conv2D(32, (3, 3), padding='same',activation='relu', name='ey-layer_1')(img_input)
x = Conv2D(64, (3, 3), padding='same', activation='relu', name='ey-layer_2')(x)
x = MaxPool2D((2, 2), strides=(2, 2), name='ey-layer_3')(x)
x = Dropout(0.25)(x)

x = Conv2D(128, (3, 3), padding='same', activation='relu', name='ey-layer_4')(x)
x = MaxPool2D((2, 2), strides=(2, 2), name='ey-layer_5')(x)
x = Dropout(0.25)(x)

x = Conv2D(256, (3, 3), padding='same', activation='relu', name='ey-layer_6')(x)
x = MaxPool2D((2, 2), strides=(2, 2), name='ey-layer_7')(x)
x = Dropout(0.25)(x)

x = Conv2D(512, (3, 3), padding='same', activation='relu', name='ey-layer_8')(x)
x = MaxPool2D((2, 2), strides=(2, 2), name='ey-layer_9')(x)
x = Dropout(0.25)(x)

x = Flatten(name='ey-layer_10')(x)
x = Dense(512, activation= 'relu', name='ey-layer_11')(x)
x = Dense(128, activation= 'relu', name='ey-layer_12')(x)
x = Dropout(0.5)(x)
x = Dense(10, activation='softmax', name='predections')(x)

# generate the model
model = Model(inputs=img_input, outputs=x, name='ey-cnn')

# print network structure
model.summary()
```

```
Model: "ey-cnn"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 ey-image-input (InputLayer)  [(None, 224, 224, 3)]    0

 ey-layer_1 (Conv2D)         (None, 224, 224, 32)      896

 ey-layer_2 (Conv2D)         (None, 224, 224, 64)      18496

 ey-layer_3 (MaxPooling2D)   (None, 112, 112, 64)      0

 dropout (Dropout)           (None, 112, 112, 64)      0

 ey-layer_4 (Conv2D)         (None, 112, 112, 128)     73856

 ey-layer_5 (MaxPooling2D)   (None, 56, 56, 128)       0

 dropout_1 (Dropout)         (None, 56, 56, 128)       0

 ey-layer_6 (Conv2D)         (None, 56, 56, 256)       295168

 ey-layer_7 (MaxPooling2D)   (None, 28, 28, 256)       0

 dropout_2 (Dropout)         (None, 28, 28, 256)       0

 ey-layer_8 (Conv2D)         (None, 28, 28, 512)       1180160

 ey-layer_9 (MaxPooling2D)   (None, 14, 14, 512)       0

 dropout_3 (Dropout)         (None, 14, 14, 512)       0

 ey-layer_10 (Flatten)       (None, 100352)            0

 ey-layer_11 (Dense)         (None, 512)               51380736

 ey-layer_12 (Dense)         (None, 128)               65664

 dropout_4 (Dropout)         (None, 128)               0

 predections (Dense)         (None, 10)                1290

=================================================================
Total params: 53,016,266
Trainable params: 53,016,266
Non-trainable params: 0
_________________________________________________________________
```

Compile Model

In [6]:

```
print("[INFO] compiling model...")
opt = Adam(learning_rate=1e-4, decay= 1e-5)
model.compile(loss="categorical_crossentropy",
              optimizer=opt,
              metrics=["accuracy"])

my_callbacks = [EarlyStopping(monitor="val_loss",
                              patience=15,
```

```
                                verbose=1,
                                mode="auto"),
                ModelCheckpoint(filepath="./models/best_model_BIGCATS.h5",
                                monitor= 'val_loss',
                                verbose= 1,
                                save_best_only= True,
                                mode = 'auto')
            ]
```

```
[INFO] compiling model...
```

Fit the model

In [7]:

```
print("[INFO] training ...")
hist = model.fit(
    traindata,
    batch_size=Batch_size,
    steps_per_epoch=traindata.samples // Batch_size,
    validation_steps=valdata.samples // Batch_size,
    epochs=EPOCHS,
    callbacks=my_callbacks,
    validation_data=valdata
)
```

```
[INFO] training ...
Epoch 1/100
73/73 [==============================] - ETA: 0s - loss: 2.3111 - accuracy: 0.0975
Epoch 1: val_loss improved from inf to 2.29269, saving model to ./models\best_model_BIG
CATS.h5
73/73 [==============================] - 27s 313ms/step - loss: 2.3111 - accuracy: 0.09
75 - val_loss: 2.2927 - val_accuracy: 0.2188
Epoch 2/100
73/73 [==============================] - ETA: 0s - loss: 2.2612 - accuracy: 0.1461
Epoch 2: val_loss improved from 2.29269 to 2.19475, saving model to ./models\best_model
_BIGCATS.h5
73/73 [==============================] - 25s 336ms/step - loss: 2.2612 - accuracy: 0.14
61 - val_loss: 2.1948 - val_accuracy: 0.2188
Epoch 3/100
73/73 [==============================] - ETA: 0s - loss: 2.1244 - accuracy: 0.2046
Epoch 3: val_loss improved from 2.19475 to 1.87129, saving model to ./models\best_model
_BIGCATS.h5
73/73 [==============================] - 25s 343ms/step - loss: 2.1244 - accuracy: 0.20
46 - val_loss: 1.8713 - val_accuracy: 0.4062
Epoch 4/100
73/73 [==============================] - ETA: 0s - loss: 1.9817 - accuracy: 0.2575
Epoch 4: val_loss did not improve from 1.87129
73/73 [==============================] - 20s 274ms/step - loss: 1.9817 - accuracy: 0.25
75 - val_loss: 2.1401 - val_accuracy: 0.1562
Epoch 5/100
73/73 [==============================] - ETA: 0s - loss: 1.8874 - accuracy: 0.2909
Epoch 5: val_loss did not improve from 1.87129
73/73 [==============================] - 20s 274ms/step - loss: 1.8874 - accuracy: 0.29
09 - val_loss: 1.9034 - val_accuracy: 0.3438
Epoch 6/100
73/73 [==============================] - ETA: 0s - loss: 1.8327 - accuracy: 0.3138
Epoch 6: val_loss improved from 1.87129 to 1.78555, saving model to ./models\best_model
_BIGCATS.h5
73/73 [==============================] - 23s 307ms/step - loss: 1.8327 - accuracy: 0.31
38 - val_loss: 1.7855 - val_accuracy: 0.3125
Epoch 7/100
73/73 [==============================] - ETA: 0s - loss: 1.7789 - accuracy: 0.3333
Epoch 7: val_loss improved from 1.78555 to 1.67756, saving model to ./models\best_model
_BIGCATS.h5
73/73 [==============================] - 22s 305ms/step - loss: 1.7789 - accuracy: 0.33
33 - val_loss: 1.6776 - val_accuracy: 0.3438
Epoch 8/100
73/73 [==============================] - ETA: 0s - loss: 1.7594 - accuracy: 0.3381
Epoch 8: val_loss did not improve from 1.67756
73/73 [==============================] - 20s 276ms/step - loss: 1.7594 - accuracy: 0.33
81 - val_loss: 1.8053 - val_accuracy: 0.3438
Epoch 9/100
73/73 [==============================] - ETA: 0s - loss: 1.7125 - accuracy: 0.3637
Epoch 9: val_loss improved from 1.67756 to 1.56504, saving model to ./models\best_model
_BIGCATS.h5
73/73 [==============================] - 22s 306ms/step - loss: 1.7125 - accuracy: 0.36
37 - val_loss: 1.5650 - val_accuracy: 0.4375
Epoch 10/100
73/73 [==============================] - ETA: 0s - loss: 1.7019 - accuracy: 0.3667
Epoch 10: val_loss did not improve from 1.56504
73/73 [==============================] - 20s 276ms/step - loss: 1.7019 - accuracy: 0.36
67 - val_loss: 1.6742 - val_accuracy: 0.3750
Epoch 11/100
73/73 [==============================] - ETA: 0s - loss: 1.6418 - accuracy: 0.3919
Epoch 11: val_loss improved from 1.56504 to 1.43866, saving model to ./models\best_mode
```

```
l_BIGCATS.h5
73/73 [==============================] - 23s 308ms/step - loss: 1.6418 - accuracy: 0.39
19 - val_loss: 1.4387 - val_accuracy: 0.5938
Epoch 12/100
73/73 [==============================] - ETA: 0s - loss: 1.6057 - accuracy: 0.3927
Epoch 12: val_loss did not improve from 1.43866
73/73 [==============================] - 20s 276ms/step - loss: 1.6057 - accuracy: 0.39
27 - val_loss: 1.4889 - val_accuracy: 0.5312
Epoch 13/100
73/73 [==============================] - ETA: 0s - loss: 1.5412 - accuracy: 0.4231
Epoch 13: val_loss improved from 1.43866 to 1.40712, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 23s 309ms/step - loss: 1.5412 - accuracy: 0.42
31 - val_loss: 1.4071 - val_accuracy: 0.5625
Epoch 14/100
73/73 [==============================] - ETA: 0s - loss: 1.4977 - accuracy: 0.4317
Epoch 14: val_loss improved from 1.40712 to 1.32838, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 26s 349ms/step - loss: 1.4977 - accuracy: 0.43
17 - val_loss: 1.3284 - val_accuracy: 0.5625
Epoch 15/100
73/73 [==============================] - ETA: 0s - loss: 1.4852 - accuracy: 0.4417
Epoch 15: val_loss did not improve from 1.32838
73/73 [==============================] - 21s 285ms/step - loss: 1.4852 - accuracy: 0.44
17 - val_loss: 1.4368 - val_accuracy: 0.5000
Epoch 16/100
73/73 [==============================] - ETA: 0s - loss: 1.4832 - accuracy: 0.4625
Epoch 16: val_loss improved from 1.32838 to 1.25678, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 23s 311ms/step - loss: 1.4832 - accuracy: 0.46
25 - val_loss: 1.2568 - val_accuracy: 0.5625
Epoch 17/100
73/73 [==============================] - ETA: 0s - loss: 1.4264 - accuracy: 0.4759
Epoch 17: val_loss improved from 1.25678 to 1.15820, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 22s 306ms/step - loss: 1.4264 - accuracy: 0.47
59 - val_loss: 1.1582 - val_accuracy: 0.5625
Epoch 18/100
73/73 [==============================] - ETA: 0s - loss: 1.3934 - accuracy: 0.4816
Epoch 18: val_loss did not improve from 1.15820
73/73 [==============================] - 20s 272ms/step - loss: 1.3934 - accuracy: 0.48
16 - val_loss: 1.2236 - val_accuracy: 0.4688
Epoch 19/100
73/73 [==============================] - ETA: 0s - loss: 1.3395 - accuracy: 0.5080
Epoch 19: val_loss did not improve from 1.15820
73/73 [==============================] - 20s 272ms/step - loss: 1.3395 - accuracy: 0.50
80 - val_loss: 1.3742 - val_accuracy: 0.5312
Epoch 20/100
73/73 [==============================] - ETA: 0s - loss: 1.3533 - accuracy: 0.4824
Epoch 20: val_loss improved from 1.15820 to 1.08137, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 22s 307ms/step - loss: 1.3533 - accuracy: 0.48
24 - val_loss: 1.0814 - val_accuracy: 0.5938
Epoch 21/100
73/73 [==============================] - ETA: 0s - loss: 1.3048 - accuracy: 0.5115
Epoch 21: val_loss did not improve from 1.08137
73/73 [==============================] - 20s 272ms/step - loss: 1.3048 - accuracy: 0.51
15 - val_loss: 1.1168 - val_accuracy: 0.5625
Epoch 22/100
73/73 [==============================] - ETA: 0s - loss: 1.2978 - accuracy: 0.5223
```

```
Epoch 22: val_loss did not improve from 1.08137
73/73 [==============================] - 20s 273ms/step - loss: 1.2978 - accuracy: 0.52
23 - val_loss: 1.1546 - val_accuracy: 0.5000
Epoch 23/100
73/73 [==============================] - ETA: 0s - loss: 1.2601 - accuracy: 0.5401
Epoch 23: val_loss did not improve from 1.08137
73/73 [==============================] - 20s 272ms/step - loss: 1.2601 - accuracy: 0.54
01 - val_loss: 1.1300 - val_accuracy: 0.5625
Epoch 24/100
73/73 [==============================] - ETA: 0s - loss: 1.2653 - accuracy: 0.5375
Epoch 24: val_loss did not improve from 1.08137
73/73 [==============================] - 20s 274ms/step - loss: 1.2653 - accuracy: 0.53
75 - val_loss: 1.1461 - val_accuracy: 0.4688
Epoch 25/100
73/73 [==============================] - ETA: 0s - loss: 1.2202 - accuracy: 0.5492
Epoch 25: val_loss did not improve from 1.08137
73/73 [==============================] - 20s 273ms/step - loss: 1.2202 - accuracy: 0.54
92 - val_loss: 1.2203 - val_accuracy: 0.5312
Epoch 26/100
73/73 [==============================] - ETA: 0s - loss: 1.1616 - accuracy: 0.5644
Epoch 26: val_loss improved from 1.08137 to 0.99860, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 22s 305ms/step - loss: 1.1616 - accuracy: 0.56
44 - val_loss: 0.9986 - val_accuracy: 0.6250
Epoch 27/100
73/73 [==============================] - ETA: 0s - loss: 1.1773 - accuracy: 0.5414
Epoch 27: val_loss did not improve from 0.99860
73/73 [==============================] - 20s 271ms/step - loss: 1.1773 - accuracy: 0.54
14 - val_loss: 1.0467 - val_accuracy: 0.5312
Epoch 28/100
73/73 [==============================] - ETA: 0s - loss: 1.1686 - accuracy: 0.5609
Epoch 28: val_loss did not improve from 0.99860
73/73 [==============================] - 20s 274ms/step - loss: 1.1686 - accuracy: 0.56
09 - val_loss: 1.0440 - val_accuracy: 0.5312
Epoch 29/100
73/73 [==============================] - ETA: 0s - loss: 1.1084 - accuracy: 0.5904
Epoch 29: val_loss did not improve from 0.99860
73/73 [==============================] - 20s 275ms/step - loss: 1.1084 - accuracy: 0.59
04 - val_loss: 1.1279 - val_accuracy: 0.5938
Epoch 30/100
73/73 [==============================] - ETA: 0s - loss: 1.0934 - accuracy: 0.5977
Epoch 30: val_loss did not improve from 0.99860
73/73 [==============================] - 20s 273ms/step - loss: 1.0934 - accuracy: 0.59
77 - val_loss: 1.0867 - val_accuracy: 0.5312
Epoch 31/100
73/73 [==============================] - ETA: 0s - loss: 1.0926 - accuracy: 0.5956
Epoch 31: val_loss improved from 0.99860 to 0.97578, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 23s 308ms/step - loss: 1.0926 - accuracy: 0.59
56 - val_loss: 0.9758 - val_accuracy: 0.6250
Epoch 32/100
73/73 [==============================] - ETA: 0s - loss: 1.0829 - accuracy: 0.5943
Epoch 32: val_loss did not improve from 0.97578
73/73 [==============================] - 20s 273ms/step - loss: 1.0829 - accuracy: 0.59
43 - val_loss: 1.0938 - val_accuracy: 0.5000
Epoch 33/100
73/73 [==============================] - ETA: 0s - loss: 1.0419 - accuracy: 0.6233
Epoch 33: val_loss improved from 0.97578 to 0.93821, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 24s 331ms/step - loss: 1.0419 - accuracy: 0.62
```

```
33 - val_loss: 0.9382 - val_accuracy: 0.6250
Epoch 34/100
73/73 [==============================] - ETA: 0s - loss: 1.0966 - accuracy: 0.5873
Epoch 34: val_loss did not improve from 0.93821
73/73 [==============================] - 20s 273ms/step - loss: 1.0966 - accuracy: 0.58
73 - val_loss: 1.0196 - val_accuracy: 0.5312
Epoch 35/100
73/73 [==============================] - ETA: 0s - loss: 1.0488 - accuracy: 0.6068
Epoch 35: val_loss did not improve from 0.93821
73/73 [==============================] - 20s 274ms/step - loss: 1.0488 - accuracy: 0.60
68 - val_loss: 1.0019 - val_accuracy: 0.6562
Epoch 36/100
73/73 [==============================] - ETA: 0s - loss: 1.0089 - accuracy: 0.6203
Epoch 36: val_loss improved from 0.93821 to 0.77894, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 22s 306ms/step - loss: 1.0089 - accuracy: 0.62
03 - val_loss: 0.7789 - val_accuracy: 0.6562
Epoch 37/100
73/73 [==============================] - ETA: 0s - loss: 0.9917 - accuracy: 0.6329
Epoch 37: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 275ms/step - loss: 0.9917 - accuracy: 0.63
29 - val_loss: 0.7848 - val_accuracy: 0.5938
Epoch 38/100
73/73 [==============================] - ETA: 0s - loss: 0.9649 - accuracy: 0.6537
Epoch 38: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 275ms/step - loss: 0.9649 - accuracy: 0.65
37 - val_loss: 0.8737 - val_accuracy: 0.6250
Epoch 39/100
73/73 [==============================] - ETA: 0s - loss: 0.9860 - accuracy: 0.6407
Epoch 39: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 274ms/step - loss: 0.9860 - accuracy: 0.64
07 - val_loss: 0.9352 - val_accuracy: 0.5938
Epoch 40/100
73/73 [==============================] - ETA: 0s - loss: 0.9221 - accuracy: 0.6554
Epoch 40: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 274ms/step - loss: 0.9221 - accuracy: 0.65
54 - val_loss: 1.0205 - val_accuracy: 0.5938
Epoch 41/100
73/73 [==============================] - ETA: 0s - loss: 0.9263 - accuracy: 0.6584
Epoch 41: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 275ms/step - loss: 0.9263 - accuracy: 0.65
84 - val_loss: 0.9090 - val_accuracy: 0.7500
Epoch 42/100
73/73 [==============================] - ETA: 0s - loss: 0.9421 - accuracy: 0.6441
Epoch 42: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 274ms/step - loss: 0.9421 - accuracy: 0.64
41 - val_loss: 1.0365 - val_accuracy: 0.5625
Epoch 43/100
73/73 [==============================] - ETA: 0s - loss: 0.8896 - accuracy: 0.6688
Epoch 43: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 275ms/step - loss: 0.8896 - accuracy: 0.66
88 - val_loss: 0.9575 - val_accuracy: 0.5625
Epoch 44/100
73/73 [==============================] - ETA: 0s - loss: 0.8919 - accuracy: 0.6619
Epoch 44: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 273ms/step - loss: 0.8919 - accuracy: 0.66
19 - val_loss: 1.0108 - val_accuracy: 0.5312
Epoch 45/100
73/73 [==============================] - ETA: 0s - loss: 0.8524 - accuracy: 0.6814
Epoch 45: val_loss did not improve from 0.77894
```

```
73/73 [==============================] - 20s 274ms/step - loss: 0.8524 - accuracy: 0.68
14 - val_loss: 0.9311 - val_accuracy: 0.5938
Epoch 46/100
73/73 [==============================] - ETA: 0s - loss: 0.8893 - accuracy: 0.6693
Epoch 46: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 274ms/step - loss: 0.8893 - accuracy: 0.66
93 - val_loss: 0.9213 - val_accuracy: 0.5938
Epoch 47/100
72/73 [============================>.] - ETA: 0s - loss: 0.8745 - accuracy: 0.6871
Epoch 47: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 273ms/step - loss: 0.8745 - accuracy: 0.68
70 - val_loss: 1.1112 - val_accuracy: 0.5312
Epoch 48/100
73/73 [==============================] - ETA: 0s - loss: 0.8410 - accuracy: 0.6836
Epoch 48: val_loss did not improve from 0.77894
73/73 [==============================] - 20s 274ms/step - loss: 0.8410 - accuracy: 0.68
36 - val_loss: 0.7989 - val_accuracy: 0.6875
Epoch 49/100
73/73 [==============================] - ETA: 0s - loss: 0.8530 - accuracy: 0.6918
Epoch 49: val_loss improved from 0.77894 to 0.72572, saving model to ./models\best_mode
l_BIGCATS.h5
73/73 [==============================] - 22s 306ms/step - loss: 0.8530 - accuracy: 0.69
18 - val_loss: 0.7257 - val_accuracy: 0.7500
Epoch 50/100
73/73 [==============================] - ETA: 0s - loss: 0.8320 - accuracy: 0.6966
Epoch 50: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 275ms/step - loss: 0.8320 - accuracy: 0.69
66 - val_loss: 0.8917 - val_accuracy: 0.6562
Epoch 51/100
73/73 [==============================] - ETA: 0s - loss: 0.7810 - accuracy: 0.7061
Epoch 51: val_loss did not improve from 0.72572
73/73 [==============================] - 21s 280ms/step - loss: 0.7810 - accuracy: 0.70
61 - val_loss: 0.9393 - val_accuracy: 0.6562
Epoch 52/100
73/73 [==============================] - ETA: 0s - loss: 0.8323 - accuracy: 0.6792
Epoch 52: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 275ms/step - loss: 0.8323 - accuracy: 0.67
92 - val_loss: 0.8939 - val_accuracy: 0.6562
Epoch 53/100
73/73 [==============================] - ETA: 0s - loss: 0.7793 - accuracy: 0.7009
Epoch 53: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 276ms/step - loss: 0.7793 - accuracy: 0.70
09 - val_loss: 0.8021 - val_accuracy: 0.6875
Epoch 54/100
73/73 [==============================] - ETA: 0s - loss: 0.7959 - accuracy: 0.7013
Epoch 54: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 273ms/step - loss: 0.7959 - accuracy: 0.70
13 - val_loss: 0.7741 - val_accuracy: 0.6875
Epoch 55/100
73/73 [==============================] - ETA: 0s - loss: 0.7926 - accuracy: 0.7031
Epoch 55: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.7926 - accuracy: 0.70
31 - val_loss: 1.0809 - val_accuracy: 0.5312
Epoch 56/100
73/73 [==============================] - ETA: 0s - loss: 0.7466 - accuracy: 0.7213
Epoch 56: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.7466 - accuracy: 0.72
13 - val_loss: 0.9160 - val_accuracy: 0.5625
Epoch 57/100
73/73 [==============================] - ETA: 0s - loss: 0.8571 - accuracy: 0.6931
```

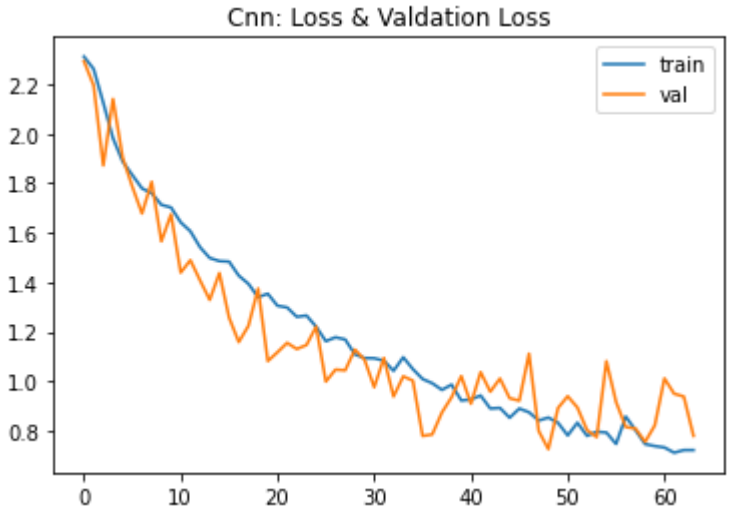
```
Epoch 57: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.8571 - accuracy: 0.69
31 - val_loss: 0.8149 - val_accuracy: 0.6250
Epoch 58/100
73/73 [==============================] - ETA: 0s - loss: 0.8026 - accuracy: 0.7070
Epoch 58: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.8026 - accuracy: 0.70
70 - val_loss: 0.8090 - val_accuracy: 0.6875
Epoch 59/100
73/73 [==============================] - ETA: 0s - loss: 0.7459 - accuracy: 0.7321
Epoch 59: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.7459 - accuracy: 0.73
21 - val_loss: 0.7549 - val_accuracy: 0.6250
Epoch 60/100
73/73 [==============================] - ETA: 0s - loss: 0.7380 - accuracy: 0.7295
Epoch 60: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 273ms/step - loss: 0.7380 - accuracy: 0.72
95 - val_loss: 0.8214 - val_accuracy: 0.6875
Epoch 61/100
73/73 [==============================] - ETA: 0s - loss: 0.7322 - accuracy: 0.7282
Epoch 61: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.7322 - accuracy: 0.72
82 - val_loss: 1.0112 - val_accuracy: 0.5938
Epoch 62/100
73/73 [==============================] - ETA: 0s - loss: 0.7112 - accuracy: 0.7412
Epoch 62: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.7112 - accuracy: 0.74
12 - val_loss: 0.9494 - val_accuracy: 0.5625
Epoch 63/100
73/73 [==============================] - ETA: 0s - loss: 0.7217 - accuracy: 0.7317
Epoch 63: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 274ms/step - loss: 0.7217 - accuracy: 0.73
17 - val_loss: 0.9381 - val_accuracy: 0.5938
Epoch 64/100
73/73 [==============================] - ETA: 0s - loss: 0.7217 - accuracy: 0.7382
Epoch 64: val_loss did not improve from 0.72572
73/73 [==============================] - 20s 273ms/step - loss: 0.7217 - accuracy: 0.73
82 - val_loss: 0.7794 - val_accuracy: 0.7188
Epoch 64: early stopping
```

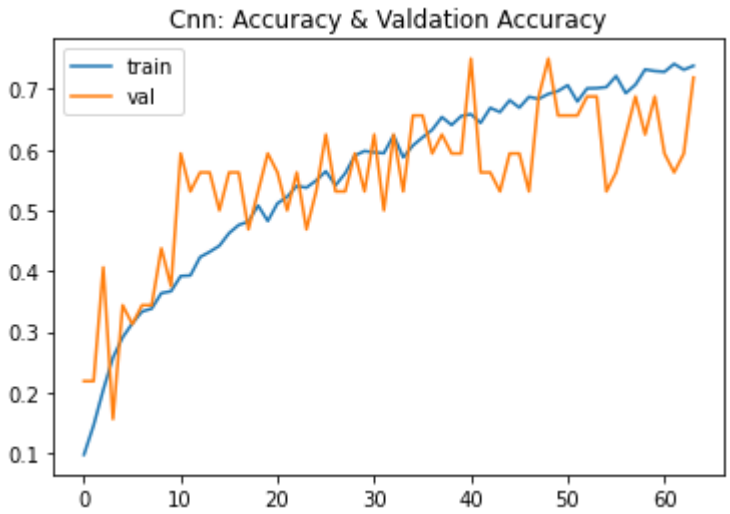
Accuracy & Loss curves

In [8]:

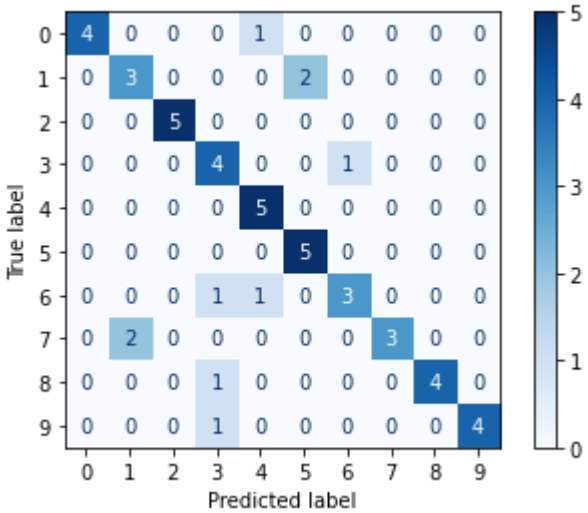
```
plt.plot(hist.history['loss'], label='train')
plt.plot(hist.history['val_loss'], label='val')
plt.title('Cnn: Loss & Valdation Loss')
plt.legend()
plt.show()

plt.plot(hist.history['accuracy'], label='train')
plt.plot(hist.history['val_accuracy'], label='val')
plt.title('Cnn: Accuracy & Valdation Accuracy')
plt.legend()
plt.show()

target_names = ["AFRICAN LEOPARD","CARACAL","CHEETAH","CLOUDED LEOPARD","JAGUAR","LIONS
labels_names =[0,1,2,3,4,5,6,7,8,9]

Y_pred = model.predict(testdata)
```

```
y_pred = np.argmax(Y_pred, axis=1)
cm = confusion_matrix(testdata.classes, y_pred, labels=labels_names)


disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=labels_names)
disp = disp.plot(cmap=plt.cm.Blues)

plt.show()
```






```
2/2 [==============================] - 1s 474ms/step
```



In [11]:
```
model = load_model("models/best_model_BIGCATS.h5")
model.evaluate(testdata)
```

```
2/2 [==============================] - 0s 29ms/step - loss: 0.6048 - accuracy: 0.8000
```

Out[11]:
```
[0.6047559380531311, 0.800000011920929]
```

ResNet50

In [12]:
```
res = tf.keras.applications.ResNet50V2(
    input_shape=(224,224,3),
    include_top=False,
)
res.trainable = False
```

Bulid resnet model

In [13]:
```
res_model = Sequential()
res_model.add(res)
res_model.add(Dropout(0.25))
res_model.add(GlobalAveragePooling2D())
res_model.add(Flatten())
res_model.add(Dense(256, activation='relu'))
res_model.add(BatchNormalization())
res_model.add(Dropout(0.5))
res_model.add(Dense(10, activation='softmax'))
res_model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 resnet50v2 (Functional)     (None, 7, 7, 2048)        23564800

 dropout_5 (Dropout)         (None, 7, 7, 2048)        0

 global_average_pooling2d (G  (None, 2048)             0
 lobalAveragePooling2D)

 flatten (Flatten)           (None, 2048)              0

 dense (Dense)               (None, 256)               524544

 batch_normalization (BatchN  (None, 256)              1024
 ormalization)

 dropout_6 (Dropout)         (None, 256)               0

 dense_1 (Dense)             (None, 10)                2570

=================================================================
Total params: 24,092,938
Trainable params: 527,626
Non-trainable params: 23,565,312
_________________________________________________________________
```

Compile the model

In [14]:

```
print("[INFO] compiling model...")
opt = Adam(learning_rate=1e-4, decay= 1e-5)
res_model.compile(loss="categorical_crossentropy",
              optimizer=opt,
              metrics=["accuracy"])

my_callbacks = [EarlyStopping(monitor="val_loss",
                              patience=5,
                              verbose=1,
                              mode="auto"),

                ModelCheckpoint(filepath="./models/best_resnetmodel_BIGCATS.h5",
                                monitor= 'val_loss',
                                verbose= 1,
                                save_best_only= True,
                                mode = 'auto')
               ]
```

```
[INFO] compiling model...
```

Train the model

In [15]:

```
print("[INFO] training ...")
hist = res_model.fit(traindata,
                     batch_size=Batch_size,
                     steps_per_epoch=traindata.samples // Batch_size,
                     validation_steps=valdata.samples // Batch_size,
```

```
                    epochs=EPOCHS,
                    callbacks=my_callbacks,
                    validation_data=valdata
                   )
```

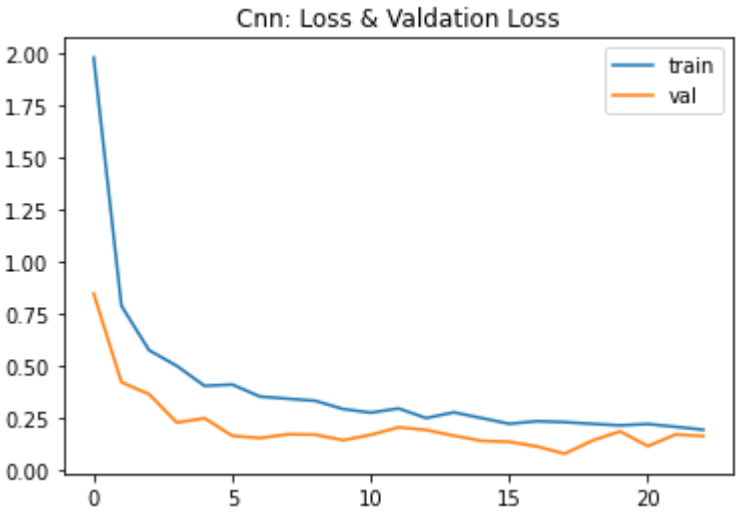
```
[INFO] training ...
Epoch 1/100
73/73 [==============================] - ETA: 0s - loss: 1.9756 - accuracy: 0.4131
Epoch 1: val_loss improved from inf to 0.84583, saving model to ./models\best_resnetmod
el_BIGCATS.h5
73/73 [==============================] - 23s 286ms/step - loss: 1.9756 - accuracy: 0.41
31 - val_loss: 0.8458 - val_accuracy: 0.6875
Epoch 2/100
73/73 [==============================] - ETA: 0s - loss: 0.7875 - accuracy: 0.7421
Epoch 2: val_loss improved from 0.84583 to 0.42228, saving model to ./models\best_resne
tmodel_BIGCATS.h5
73/73 [==============================] - 21s 281ms/step - loss: 0.7875 - accuracy: 0.74
21 - val_loss: 0.4223 - val_accuracy: 0.8438
Epoch 3/100
73/73 [==============================] - ETA: 0s - loss: 0.5750 - accuracy: 0.8223
Epoch 3: val_loss improved from 0.42228 to 0.36429, saving model to ./models\best_resne
tmodel_BIGCATS.h5
73/73 [==============================] - 20s 276ms/step - loss: 0.5750 - accuracy: 0.82
23 - val_loss: 0.3643 - val_accuracy: 0.8438
Epoch 4/100
73/73 [==============================] - ETA: 0s - loss: 0.5002 - accuracy: 0.8461
Epoch 4: val_loss improved from 0.36429 to 0.22882, saving model to ./models\best_resne
tmodel_BIGCATS.h5
73/73 [==============================] - 21s 281ms/step - loss: 0.5002 - accuracy: 0.84
61 - val_loss: 0.2288 - val_accuracy: 0.9375
Epoch 5/100
73/73 [==============================] - ETA: 0s - loss: 0.4046 - accuracy: 0.8682
Epoch 5: val_loss did not improve from 0.22882
73/73 [==============================] - 20s 273ms/step - loss: 0.4046 - accuracy: 0.86
82 - val_loss: 0.2498 - val_accuracy: 0.8750
Epoch 6/100
73/73 [==============================] - ETA: 0s - loss: 0.4110 - accuracy: 0.8726
Epoch 6: val_loss improved from 0.22882 to 0.16542, saving model to ./models\best_resne
tmodel_BIGCATS.h5
73/73 [==============================] - 20s 280ms/step - loss: 0.4110 - accuracy: 0.87
26 - val_loss: 0.1654 - val_accuracy: 0.9375
Epoch 7/100
73/73 [==============================] - ETA: 0s - loss: 0.3532 - accuracy: 0.8860
Epoch 7: val_loss improved from 0.16542 to 0.15456, saving model to ./models\best_resne
tmodel_BIGCATS.h5
73/73 [==============================] - 20s 279ms/step - loss: 0.3532 - accuracy: 0.88
60 - val_loss: 0.1546 - val_accuracy: 0.9375
Epoch 8/100
73/73 [==============================] - ETA: 0s - loss: 0.3430 - accuracy: 0.8964
Epoch 8: val_loss did not improve from 0.15456
73/73 [==============================] - 20s 278ms/step - loss: 0.3430 - accuracy: 0.89
64 - val_loss: 0.1727 - val_accuracy: 0.9062
Epoch 9/100
73/73 [==============================] - ETA: 0s - loss: 0.3329 - accuracy: 0.8934
Epoch 9: val_loss did not improve from 0.15456
73/73 [==============================] - 20s 274ms/step - loss: 0.3329 - accuracy: 0.89
34 - val_loss: 0.1708 - val_accuracy: 0.9375
Epoch 10/100
73/73 [==============================] - ETA: 0s - loss: 0.2937 - accuracy: 0.9020
Epoch 10: val_loss improved from 0.15456 to 0.14438, saving model to ./models\best_resn
etmodel_BIGCATS.h5
73/73 [==============================] - 21s 280ms/step - loss: 0.2937 - accuracy: 0.90
20 - val_loss: 0.1444 - val_accuracy: 0.9062
Epoch 11/100
73/73 [==============================] - ETA: 0s - loss: 0.2762 - accuracy: 0.9098
```

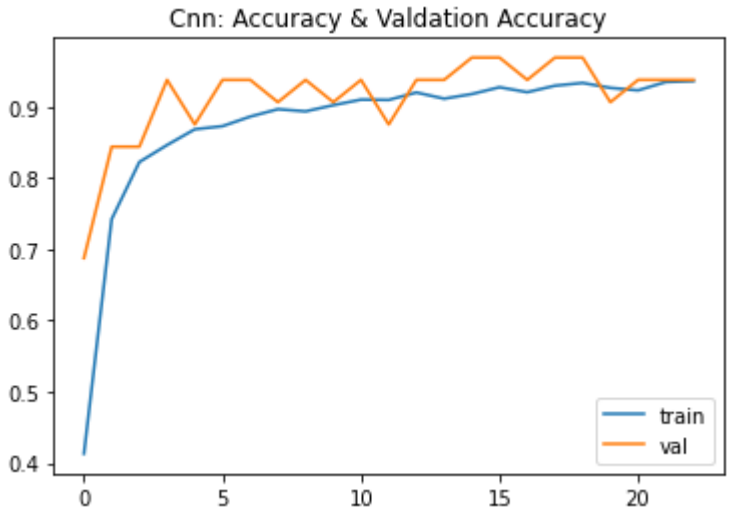
```
Epoch 11: val_loss did not improve from 0.14438
73/73 [==============================] - 20s 273ms/step - loss: 0.2762 - accuracy: 0.90
98 - val_loss: 0.1701 - val_accuracy: 0.9375
Epoch 12/100
73/73 [==============================] - ETA: 0s - loss: 0.2964 - accuracy: 0.9094
Epoch 12: val_loss did not improve from 0.14438
73/73 [==============================] - 20s 277ms/step - loss: 0.2964 - accuracy: 0.90
94 - val_loss: 0.2059 - val_accuracy: 0.8750
Epoch 13/100
73/73 [==============================] - ETA: 0s - loss: 0.2503 - accuracy: 0.9198
Epoch 13: val_loss did not improve from 0.14438
73/73 [==============================] - 20s 274ms/step - loss: 0.2503 - accuracy: 0.91
98 - val_loss: 0.1936 - val_accuracy: 0.9375
Epoch 14/100
73/73 [==============================] - ETA: 0s - loss: 0.2777 - accuracy: 0.9111
Epoch 14: val_loss did not improve from 0.14438
73/73 [==============================] - 20s 277ms/step - loss: 0.2777 - accuracy: 0.91
11 - val_loss: 0.1659 - val_accuracy: 0.9375
Epoch 15/100
73/73 [==============================] - ETA: 0s - loss: 0.2503 - accuracy: 0.9176
Epoch 15: val_loss improved from 0.14438 to 0.14129, saving model to ./models\best_resn
etmodel_BIGCATS.h5
73/73 [==============================] - 20s 279ms/step - loss: 0.2503 - accuracy: 0.91
76 - val_loss: 0.1413 - val_accuracy: 0.9688
Epoch 16/100
73/73 [==============================] - ETA: 0s - loss: 0.2229 - accuracy: 0.9272
Epoch 16: val_loss improved from 0.14129 to 0.13677, saving model to ./models\best_resn
etmodel_BIGCATS.h5
73/73 [==============================] - 20s 279ms/step - loss: 0.2229 - accuracy: 0.92
72 - val_loss: 0.1368 - val_accuracy: 0.9688
Epoch 17/100
73/73 [==============================] - ETA: 0s - loss: 0.2353 - accuracy: 0.9202
Epoch 17: val_loss improved from 0.13677 to 0.11419, saving model to ./models\best_resn
etmodel_BIGCATS.h5
73/73 [==============================] - 20s 277ms/step - loss: 0.2353 - accuracy: 0.92
02 - val_loss: 0.1142 - val_accuracy: 0.9375
Epoch 18/100
73/73 [==============================] - ETA: 0s - loss: 0.2310 - accuracy: 0.9293
Epoch 18: val_loss improved from 0.11419 to 0.07986, saving model to ./models\best_resn
etmodel_BIGCATS.h5
73/73 [==============================] - 21s 281ms/step - loss: 0.2310 - accuracy: 0.92
93 - val_loss: 0.0799 - val_accuracy: 0.9688
Epoch 19/100
73/73 [==============================] - ETA: 0s - loss: 0.2226 - accuracy: 0.9332
Epoch 19: val_loss did not improve from 0.07986
73/73 [==============================] - 20s 275ms/step - loss: 0.2226 - accuracy: 0.93
32 - val_loss: 0.1427 - val_accuracy: 0.9688
Epoch 20/100
73/73 [==============================] - ETA: 0s - loss: 0.2154 - accuracy: 0.9263
Epoch 20: val_loss did not improve from 0.07986
73/73 [==============================] - 20s 277ms/step - loss: 0.2154 - accuracy: 0.92
63 - val_loss: 0.1868 - val_accuracy: 0.9062
Epoch 21/100
73/73 [==============================] - ETA: 0s - loss: 0.2219 - accuracy: 0.9228
Epoch 21: val_loss did not improve from 0.07986
73/73 [==============================] - 20s 274ms/step - loss: 0.2219 - accuracy: 0.92
28 - val_loss: 0.1162 - val_accuracy: 0.9375
Epoch 22/100
73/73 [==============================] - ETA: 0s - loss: 0.2086 - accuracy: 0.9345
Epoch 22: val_loss did not improve from 0.07986
```

```
73/73 [==============================] - 20s 276ms/step - loss: 0.2086 - accuracy: 0.93
45 - val_loss: 0.1719 - val_accuracy: 0.9375
Epoch 23/100
73/73 [==============================] - ETA: 0s - loss: 0.1945 - accuracy: 0.9358
Epoch 23: val_loss did not improve from 0.07986
73/73 [==============================] - 20s 275ms/step - loss: 0.1945 - accuracy: 0.93
58 - val_loss: 0.1640 - val_accuracy: 0.9375
Epoch 23: early stopping
```

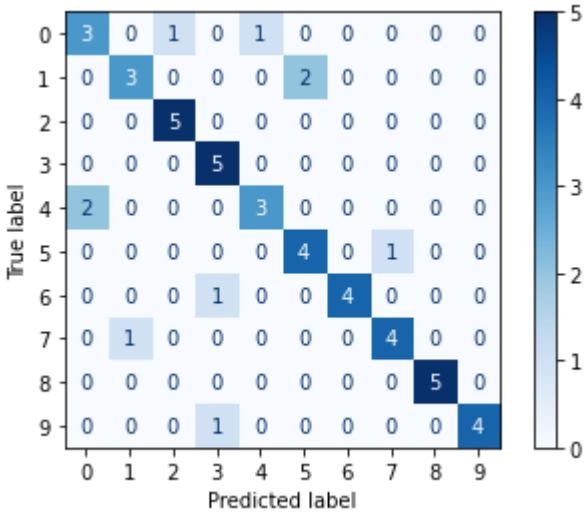
Accuracy & Loss curves

In [16]:
```
plt.plot(hist.history['loss'], label='train')
plt.plot(hist.history['val_loss'], label='val')
plt.title('Cnn: Loss & Valdation Loss')
plt.legend()
plt.show()

plt.plot(hist.history['accuracy'], label='train')
plt.plot(hist.history['val_accuracy'], label='val')
plt.title('Cnn: Accuracy & Valdation Accuracy')
plt.legend()
plt.show()

target_names = ["AFRICAN LEOPARD","CARACAL","CHEETAH","CLOUDED LEOPARD","JAGUAR","LIONS
labels_names =[0,1,2,3,4,5,6,7,8,9]

Y_pred = model.predict(testdata)
y_pred = np.argmax(Y_pred, axis=1)
cm = confusion_matrix(testdata.classes, y_pred, labels=labels_names)


disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=labels_names)
disp = disp.plot(cmap=plt.cm.Blues)

plt.show()
```






```
2/2 [==============================] - 0s 39ms/step
```



In [17]:
```
res_model = load_model("models/best_resnetmodel_BIGCATS.h5")
res_model.evaluate(testdata)
```

```
2/2 [==============================] - 1s 489ms/step - loss: 0.0333 - accuracy: 1.000
```

Out[17]:
```
[0.03334430605173111, 1.0]
```