```
import os
import numpy as np
import pandas as pd
import tensorflow as tf
import matplotlib.pyplot as plt
import plotly.express as px

from tensorflow import keras
from tensorflow.keras import layers
from tensorflow.keras.applications import InceptionV3
from tensorflow.keras.layers import Conv2D,Add,MaxPooling2D, Dense, BatchNormalization,Input,Flatten, Dropout,GlobalMax
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam,RMSprop
from tensorflow.keras.callbacks import LearningRateScheduler
from tensorflow.keras.preprocessing.image import ImageDataGenerator


#unzip files
!unzip -q Pets.zip
!ls
!ls test
```

```
replace test/cats/cat_1.jpg? [y]es, [n]o, [A]ll, [N]one, [r]ename: N
model.png  Pets.zip  sample_data  test  train
cats  dogs
```

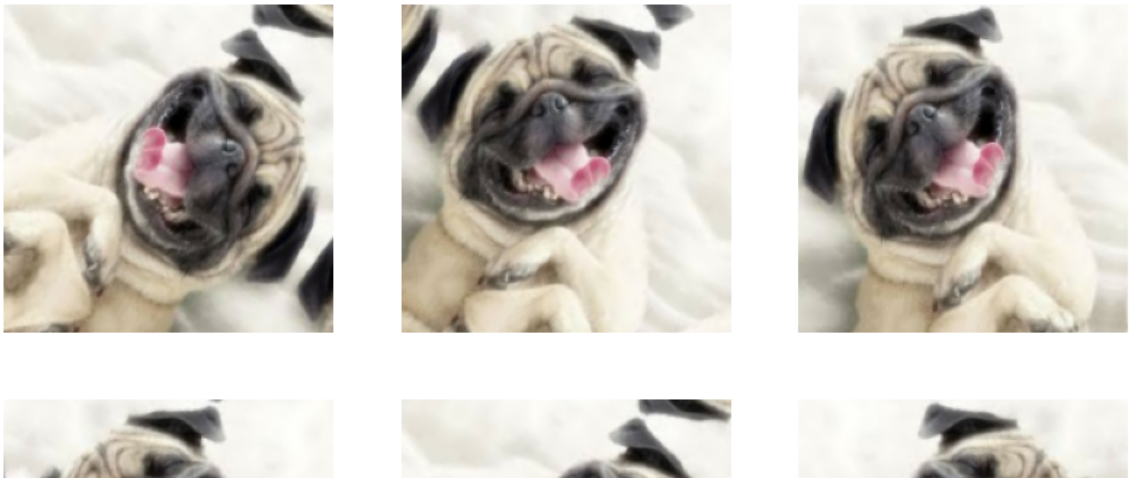
```
#split data
image_size = (180, 180)
batch_size = 128

train_ds, val_ds = tf.keras.utils.image_dataset_from_directory(
    "train",
    validation_split=0.2,
    subset="both",
    seed=1234,
    image_size=image_size,
    batch_size=batch_size,
)
```

```
Found 557 files belonging to 2 classes.
Using 446 files for training.
Using 111 files for validation.
```

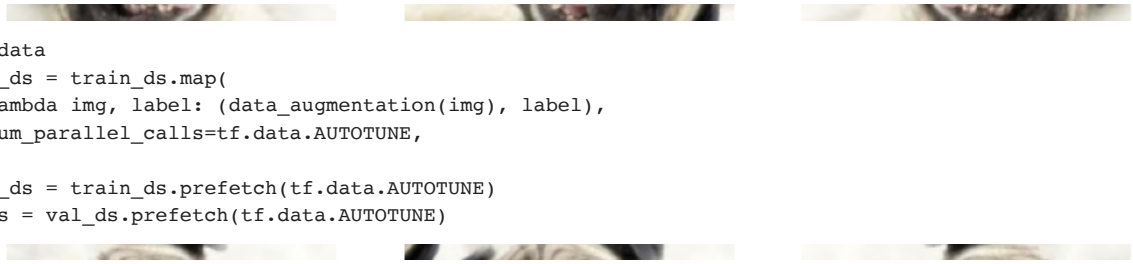
```
#show sample of data labeling 1 for dog 0 for cat
import matplotlib.pyplot as plt

plt.figure(figsize=(10, 10))
for images, labels in train_ds.take(1):
    for i in range(9):
        ax = plt.subplot(3, 3, i + 1)
        plt.imshow(images[i].numpy().astype("uint8"))
        plt.title(int(labels[i]))
        plt.axis("off")
```


```
#augment data
data_augmentation = keras.Sequential(
    [
        layers.RandomFlip("horizontal"),
        layers.RandomRotation(0.1),
    ]
)
```

```
#show sample of augmented data
plt.figure(figsize=(10, 10))
for images, _ in train_ds.take(1):
    for i in range(9):
        augmented_images = data_augmentation(images)
        ax = plt.subplot(3, 3, i + 1)
        plt.imshow(augmented_images[0].numpy().astype("uint8"))
        plt.axis("off")
```



```
#augment data
augmented_train_ds = train_ds.map(
    lambda x, y: (data_augmentation(x, training=True), y))
```

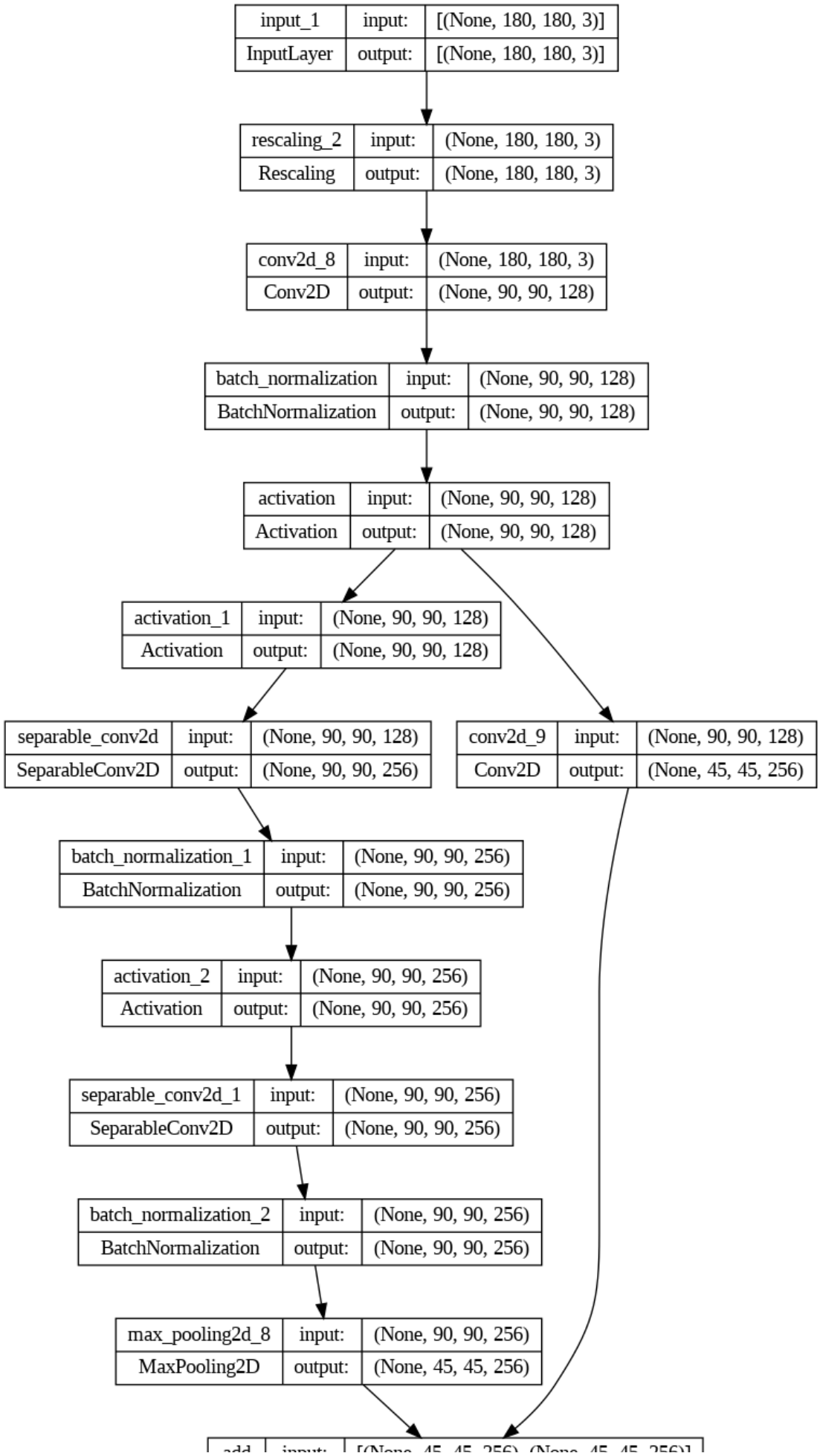


```
#get data
train_ds = train_ds.map(
    lambda img, label: (data_augmentation(img), label),
    num_parallel_calls=tf.data.AUTOTUNE,
)
train_ds = train_ds.prefetch(tf.data.AUTOTUNE)
val_ds = val_ds.prefetch(tf.data.AUTOTUNE)
```



```
#define architecture of model
def make_model(input_shape, num_classes):
    inputs = keras.Input(shape=input_shape)

    x = layers.Rescaling(1.0 / 255)(inputs)
    x = layers.Conv2D(128, 3, strides=2, padding="same")(x)
    x = layers.BatchNormalization()(x)
    x = layers.Activation("relu")(x)

    previous_block_activation = x

    for size in [256, 512, 728]:
        x = layers.Activation("relu")(x)
        x = layers.SeparableConv2D(size, 3, padding="same")(x)
        x = layers.BatchNormalization()(x)

        x = layers.Activation("relu")(x)
        x = layers.SeparableConv2D(size, 3, padding="same")(x)
        x = layers.BatchNormalization()(x)

        x = layers.MaxPooling2D(3, strides=2, padding="same")(x)

        residual = layers.Conv2D(size, 1, strides=2, padding="same")(
            previous_block_activation
        )
        x = layers.add([x, residual])
        previous_block_activation = x  # Set aside next residual

    x = layers.SeparableConv2D(1024, 3, padding="same")(x)
    x = layers.BatchNormalization()(x)
    x = layers.Activation("relu")(x)

    x = layers.GlobalAveragePooling2D()(x)
    if num_classes == 2:
        activation = "sigmoid"
        units = 1
    else:
        activation = "softmax"
        units = num_classes
```

```
        x = layers.Dropout(0.5)(x)
        outputs = layers.Dense(units, activation=activation)(x)
        return keras.Model(inputs, outputs)

    model = make_model(input_shape=image_size + (3,), num_classes=2)
    keras.utils.plot_model(model, show_shapes=True)
```


input_1 | input: | [(None, 180, 180, 3)]
InputLayer | output: | [(None, 180, 180, 3)]
rescaling_2 | input: | (None, 180, 180, 3)
Rescaling | output: | (None, 180, 180, 3)
conv2d_8 | input: | (None, 180, 180, 3)
Conv2D | output: | (None, 90, 90, 128)
batch_normalization | input: | (None, 90, 90, 128)
BatchNormalization | output: | (None, 90, 90, 128)
activation | input: | (None, 90, 90, 128)
Activation | output: | (None, 90, 90, 128)
activation_1 | input: | (None, 90, 90, 128)
Activation | output: | (None, 90, 90, 128)
separable_conv2d | input: | (None, 90, 90, 128)
SeparableConv2D | output: | (None, 90, 90, 256)
conv2d_9 | input: | (None, 90, 90, 128)
Conv2D | output: | (None, 45, 45, 256)
batch_normalization_1 | input: | (None, 90, 90, 256)
BatchNormalization | output: | (None, 90, 90, 256)
activation_2 | input: | (None, 90, 90, 256)
Activation | output: | (None, 90, 90, 256)
separable_conv2d_1 | input: | (None, 90, 90, 256)
SeparableConv2D | output: | (None, 90, 90, 256)
batch_normalization_2 | input: | (None, 90, 90, 256)
BatchNormalization | output: | (None, 90, 90, 256)
max_pooling2d_8 | input: | (None, 90, 90, 256)
MaxPooling2D | output: | (None, 45, 45, 256)

| add | Input: | [(None, 45, 45, 256), (None, 45, 45, 256)] |

```
#evaluate using CNN
from tensorflow import keras
from tensorflow.keras import layers
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Dense, BatchNormalization, Input, Flatten, Dropout
from tensorflow.keras.models import Model
from tensorflow.keras.optimizers import Adam, RMSprop
from tensorflow.keras.preprocessing.image import ImageDataGenerator

model = keras.Sequential([
    layers.experimental.preprocessing.Rescaling(1./255, input_shape=(180, 180, 3)),
    layers.Conv2D(32, 3, activation='relu'),
    layers.MaxPooling2D(),
    layers.Conv2D(64, 3, activation='relu'),
    layers.MaxPooling2D(),
    layers.Conv2D(128, 3, activation='relu'),
    layers.MaxPooling2D(),
    layers.Conv2D(256, 3, activation='relu'),
    layers.MaxPooling2D(),
    layers.Flatten(),
    layers.Dense(512, activation='relu'),
    layers.Dropout(0.5),
    layers.Dense(1, activation='sigmoid')
])
```

```
model.compile(
    optimizer=keras.optimizers.Adam(1e-3),
    loss="binary_crossentropy",
    metrics=["accuracy"],
)

history = model.fit(
    train_ds,
    epochs=10,
    callbacks=[keras.callbacks.ModelCheckpoint("save_at_{epoch}.keras"),],
    validation_data=val_ds,
)
```

```
    ========================] - 50s 11s/step - loss: 1.1292 - accuracy: 0.4910 - val_loss: 0.7149 - val_accuracy: 0.48

    ========================] - 52s 11s/step - loss: 0.7032 - accuracy: 0.5045 - val_loss: 0.6938 - val_accuracy: 0.48

    ========================] - 47s 11s/step - loss: 0.6934 - accuracy: 0.5067 - val_loss: 0.6921 - val_accuracy: 0.51

    ========================] - 46s 11s/step - loss: 0.6934 - accuracy: 0.5000 - val_loss: 0.6932 - val_accuracy: 0.49

    ========================] - 46s 11s/step - loss: 0.6923 - accuracy: 0.5112 - val_loss: 0.6918 - val_accuracy: 0.49

    ========================] - 47s 11s/step - loss: 0.6866 - accuracy: 0.5785 - val_loss: 0.6926 - val_accuracy: 0.50

    ========================] - 44s 10s/step - loss: 0.6782 - accuracy: 0.5650 - val_loss: 0.7117 - val_accuracy: 0.51

    ========================] - 47s 11s/step - loss: 0.6957 - accuracy: 0.5157 - val_loss: 0.6868 - val_accuracy: 0.51

    ========================] - 53s 10s/step - loss: 0.6793 - accuracy: 0.5628 - val_loss: 0.6738 - val_accuracy: 0.60

    ========================] - 46s 10s/step - loss: 0.6568 - accuracy: 0.6413 - val_loss: 0.6789 - val_accuracy: 0.58
```

```
#Train model

model.compile(
    optimizer=keras.optimizers.Adam(1e-3),
    loss="binary_crossentropy",
    metrics=["accuracy"],
)

history = model.fit(
    train_ds,
    epochs= 5,
```

```
        callbacks=[LearningRateScheduler(lambda epoch: 1e-3 * (0.8 ** epoch))],
    validation_data=val_ds,
)

model.evaluate(train_ds)
```

```
Epoch 1/5
                                                    |                                                    |
```

```
# Analysis report:
# We can see that after using CNN we got an increase in accuracy. before it was at 50%
# , now it is at 60% which is an increase. I think this is mainly because we trained the model for less,
# All in all, it was interesting to see the architecture at work, and the different layers going into the CNN model
```