Pixab_CAM python implementation

October 5, 2021

1 Pixab-CAM visual explanation map

1.1 Setup

```python
[1]: import numpy as np
     import matplotlib.pyplot as plt
     import matplotlib.cm as cm
     import tensorflow as tf
     import skimage.io
     import skimage.transform
     import requests
     from PIL import Image
     from io import BytesIO
     import os
     from itertools import combinations_with_replacement
```

1.2 Prepare the pretrained model and the elements to create a visual explanation map

You can change these to another model.

```python
[2]: ## Black box model pretrained on the ImageNet
     model_builder = tf.keras.applications.inception_v3.InceptionV3
     decode_predictions = tf.keras.applications.inception_v3.decode_predictions
     model = model_builder(weights="imagenet")

     ## You can get "last convolution layer" & "classifier layer" & "input size" from␣
     ↪".summary()"
     print(model.summary())
     last_conv_layer_name = "mixed10"
     classifier_layer_names = ["avg_pool", "predictions"]
     input_size = (299, 299)
```

```
Model: "inception_v3"
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_____
Layer (type)                    Output Shape         Param #     Connected to
=================================================================================
```

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==================
input_1 (InputLayer)            [(None, 299, 299, 3)  0
-------------------------------------------------------------------------------
------------------
conv2d (Conv2D)                 (None, 149, 149, 32)  864          input_1[0][0]
-------------------------------------------------------------------------------
------------------
batch_normalization (BatchNorma (None, 149, 149, 32)  96           conv2d[0][0]
-------------------------------------------------------------------------------
------------------
activation (Activation)         (None, 149, 149, 32)  0
batch_normalization[0][0]
-------------------------------------------------------------------------------
------------------
conv2d_1 (Conv2D)               (None, 147, 147, 32)  9216
activation[0][0]
-------------------------------------------------------------------------------
------------------
batch_normalization_1 (BatchNor (None, 147, 147, 32)  96           conv2d_1[0][0]
-------------------------------------------------------------------------------
------------------
activation_1 (Activation)       (None, 147, 147, 32)  0
batch_normalization_1[0][0]
-------------------------------------------------------------------------------
------------------
conv2d_2 (Conv2D)               (None, 147, 147, 64)  18432
activation_1[0][0]
-------------------------------------------------------------------------------
------------------
batch_normalization_2 (BatchNor (None, 147, 147, 64)  192          conv2d_2[0][0]
-------------------------------------------------------------------------------
------------------
activation_2 (Activation)       (None, 147, 147, 64)  0
batch_normalization_2[0][0]
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------------------
max_pooling2d (MaxPooling2D)    (None, 73, 73, 64)    0
activation_2[0][0]
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------------------
conv2d_3 (Conv2D)               (None, 73, 73, 80)    5120
max_pooling2d[0][0]
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------------------
batch_normalization_3 (BatchNor (None, 73, 73, 80)    240          conv2d_3[0][0]
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------------------
activation_3 (Activation)       (None, 73, 73, 80)    0
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                                                batch_normalization_3[0][0]
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_____
conv2d_4 (Conv2D)              (None, 71, 71, 192)  138240
activation_3[0][0]
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_____
batch_normalization_4 (BatchNor (None, 71, 71, 192)  576        conv2d_4[0][0]
_____
_____
activation_4 (Activation)      (None, 71, 71, 192)  0
batch_normalization_4[0][0]
_____
_____
max_pooling2d_1 (MaxPooling2D)  (None, 35, 35, 192)  0
activation_4[0][0]
_____
_____
conv2d_8 (Conv2D)              (None, 35, 35, 64)   12288
max_pooling2d_1[0][0]
_____
_____
batch_normalization_8 (BatchNor (None, 35, 35, 64)   192        conv2d_8[0][0]
_____
_____
activation_8 (Activation)      (None, 35, 35, 64)   0
batch_normalization_8[0][0]
_____
_____
conv2d_6 (Conv2D)              (None, 35, 35, 48)   9216
max_pooling2d_1[0][0]
_____
_____
conv2d_9 (Conv2D)              (None, 35, 35, 96)   55296
activation_8[0][0]
_____
_____
batch_normalization_6 (BatchNor (None, 35, 35, 48)   144        conv2d_6[0][0]
_____
_____
batch_normalization_9 (BatchNor (None, 35, 35, 96)   288        conv2d_9[0][0]
_____
_____
activation_6 (Activation)      (None, 35, 35, 48)   0
batch_normalization_6[0][0]
_____
_____
activation_9 (Activation)      (None, 35, 35, 96)   0
```

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batch_normalization_9[0][0]
_____
_____
average_pooling2d (AveragePooli (None, 35, 35, 192)   0
max_pooling2d_1[0][0]
_____
_____
conv2d_5 (Conv2D)               (None, 35, 35, 64)    12288
max_pooling2d_1[0][0]
_____
_____
conv2d_7 (Conv2D)               (None, 35, 35, 64)    76800
activation_6[0][0]
_____
_____
conv2d_10 (Conv2D)              (None, 35, 35, 96)    82944
activation_9[0][0]
_____
_____
conv2d_11 (Conv2D)              (None, 35, 35, 32)    6144
average_pooling2d[0][0]
_____
_____
batch_normalization_5 (BatchNor (None, 35, 35, 64)    192         conv2d_5[0][0]
_____
_____
batch_normalization_7 (BatchNor (None, 35, 35, 64)    192         conv2d_7[0][0]
_____
_____
batch_normalization_10 (BatchNo (None, 35, 35, 96)    288         conv2d_10[0][0]
_____
_____
batch_normalization_11 (BatchNo (None, 35, 35, 32)    96          conv2d_11[0][0]
_____
_____
activation_5 (Activation)       (None, 35, 35, 64)    0
batch_normalization_5[0][0]
_____
_____
activation_7 (Activation)       (None, 35, 35, 64)    0
batch_normalization_7[0][0]
_____
_____
activation_10 (Activation)      (None, 35, 35, 96)    0
batch_normalization_10[0][0]
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_____
activation_11 (Activation)      (None, 35, 35, 32)    0
```

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batch_normalization_11[0][0]

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------------------
mixed0 (Concatenate)            (None, 35, 35, 256)  0
activation_5[0][0]
activation_7[0][0]
activation_10[0][0]
activation_11[0][0]

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------------------
conv2d_15 (Conv2D)              (None, 35, 35, 64)   16384     mixed0[0][0]

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------------------
batch_normalization_15 (BatchNo (None, 35, 35, 64)   192       conv2d_15[0][0]

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------------------
activation_15 (Activation)      (None, 35, 35, 64)   0
batch_normalization_15[0][0]

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------------------
conv2d_13 (Conv2D)              (None, 35, 35, 48)   12288     mixed0[0][0]

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conv2d_16 (Conv2D)              (None, 35, 35, 96)   55296
activation_15[0][0]

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------------------
batch_normalization_13 (BatchNo (None, 35, 35, 48)   144       conv2d_13[0][0]

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batch_normalization_16 (BatchNo (None, 35, 35, 96)   288       conv2d_16[0][0]

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------------------
activation_13 (Activation)      (None, 35, 35, 48)   0
batch_normalization_13[0][0]

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------------------
activation_16 (Activation)      (None, 35, 35, 96)   0
batch_normalization_16[0][0]

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------------------
average_pooling2d_1 (AveragePoo (None, 35, 35, 256)  0         mixed0[0][0]

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------------------
conv2d_12 (Conv2D)              (None, 35, 35, 64)   16384     mixed0[0][0]

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conv2d_14 (Conv2D)              (None, 35, 35, 64)   76800
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                                             activation_13[0][0]
_____
_____
conv2d_17 (Conv2D)              (None, 35, 35, 96)   82944
activation_16[0][0]
_____
_____
conv2d_18 (Conv2D)              (None, 35, 35, 64)   16384
average_pooling2d_1[0][0]
_____
_____
batch_normalization_12 (BatchNo (None, 35, 35, 64)   192       conv2d_12[0][0]
_____
_____
batch_normalization_14 (BatchNo (None, 35, 35, 64)   192       conv2d_14[0][0]
_____
_____
batch_normalization_17 (BatchNo (None, 35, 35, 96)   288       conv2d_17[0][0]
_____
_____
batch_normalization_18 (BatchNo (None, 35, 35, 64)   192       conv2d_18[0][0]
_____
_____
activation_12 (Activation)      (None, 35, 35, 64)   0
batch_normalization_12[0][0]
_____
_____
activation_14 (Activation)      (None, 35, 35, 64)   0
batch_normalization_14[0][0]
_____
_____
activation_17 (Activation)      (None, 35, 35, 96)   0
batch_normalization_17[0][0]
_____
_____
activation_18 (Activation)      (None, 35, 35, 64)   0
batch_normalization_18[0][0]
_____
_____
mixed1 (Concatenate)            (None, 35, 35, 288)  0
activation_12[0][0]
activation_14[0][0]
activation_17[0][0]
activation_18[0][0]
_____
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conv2d_22 (Conv2D)              (None, 35, 35, 64)   18432     mixed1[0][0]
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batch_normalization_22 (BatchNo (None, 35, 35, 64)   192        conv2d_22[0][0]
--------------------------------------------------------------------------------
------------------
activation_22 (Activation)      (None, 35, 35, 64)   0
batch_normalization_22[0][0]
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------------------
conv2d_20 (Conv2D)              (None, 35, 35, 48)   13824      mixed1[0][0]
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------------------
conv2d_23 (Conv2D)              (None, 35, 35, 96)   55296
activation_22[0][0]
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------------------
batch_normalization_20 (BatchNo (None, 35, 35, 48)   144        conv2d_20[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_23 (BatchNo (None, 35, 35, 96)   288        conv2d_23[0][0]
--------------------------------------------------------------------------------
------------------
activation_20 (Activation)      (None, 35, 35, 48)   0
batch_normalization_20[0][0]
--------------------------------------------------------------------------------
------------------
activation_23 (Activation)      (None, 35, 35, 96)   0
batch_normalization_23[0][0]
--------------------------------------------------------------------------------
------------------
average_pooling2d_2 (AveragePoo (None, 35, 35, 288)  0          mixed1[0][0]
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------------------
conv2d_19 (Conv2D)              (None, 35, 35, 64)   18432      mixed1[0][0]
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------------------
conv2d_21 (Conv2D)              (None, 35, 35, 64)   76800
activation_20[0][0]
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------------------
conv2d_24 (Conv2D)              (None, 35, 35, 96)   82944
activation_23[0][0]
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------------------
conv2d_25 (Conv2D)              (None, 35, 35, 64)   18432
average_pooling2d_2[0][0]
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------------------
batch_normalization_19 (BatchNo (None, 35, 35, 64)   192        conv2d_19[0][0]
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batch_normalization_21 (BatchNo (None, 35, 35, 64)   192         conv2d_21[0][0]
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------------------
batch_normalization_24 (BatchNo (None, 35, 35, 96)   288         conv2d_24[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_25 (BatchNo (None, 35, 35, 64)   192         conv2d_25[0][0]
--------------------------------------------------------------------------------
------------------
activation_19 (Activation)      (None, 35, 35, 64)   0
batch_normalization_19[0][0]
--------------------------------------------------------------------------------
------------------
activation_21 (Activation)      (None, 35, 35, 64)   0
batch_normalization_21[0][0]
--------------------------------------------------------------------------------
------------------
activation_24 (Activation)      (None, 35, 35, 96)   0
batch_normalization_24[0][0]
--------------------------------------------------------------------------------
------------------
activation_25 (Activation)      (None, 35, 35, 64)   0
batch_normalization_25[0][0]
--------------------------------------------------------------------------------
------------------
mixed2 (Concatenate)            (None, 35, 35, 288)  0
activation_19[0][0]
activation_21[0][0]
activation_24[0][0]
activation_25[0][0]
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------------------
conv2d_27 (Conv2D)              (None, 35, 35, 64)   18432       mixed2[0][0]
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------------------
batch_normalization_27 (BatchNo (None, 35, 35, 64)   192         conv2d_27[0][0]
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------------------
activation_27 (Activation)      (None, 35, 35, 64)   0
batch_normalization_27[0][0]
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------------------
conv2d_28 (Conv2D)              (None, 35, 35, 96)   55296
activation_27[0][0]
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batch_normalization_28 (BatchNo (None, 35, 35, 96)   288         conv2d_28[0][0]
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_____
activation_28 (Activation)      (None, 35, 35, 96)   0
batch_normalization_28[0][0]
_____
_____
conv2d_26 (Conv2D)              (None, 17, 17, 384)  995328      mixed2[0][0]
_____
_____
conv2d_29 (Conv2D)              (None, 17, 17, 96)   82944
activation_28[0][0]
_____
_____
batch_normalization_26 (BatchNo (None, 17, 17, 384)  1152        conv2d_26[0][0]
_____
_____
batch_normalization_29 (BatchNo (None, 17, 17, 96)   288         conv2d_29[0][0]
_____
_____
activation_26 (Activation)      (None, 17, 17, 384)  0
batch_normalization_26[0][0]
_____
_____
activation_29 (Activation)      (None, 17, 17, 96)   0
batch_normalization_29[0][0]
_____
_____
max_pooling2d_2 (MaxPooling2D)  (None, 17, 17, 288)  0           mixed2[0][0]
_____
_____
mixed3 (Concatenate)            (None, 17, 17, 768)  0
activation_26[0][0]
activation_29[0][0]
max_pooling2d_2[0][0]
_____
_____
conv2d_34 (Conv2D)              (None, 17, 17, 128)  98304       mixed3[0][0]
_____
_____
batch_normalization_34 (BatchNo (None, 17, 17, 128)  384         conv2d_34[0][0]
_____
_____
activation_34 (Activation)      (None, 17, 17, 128)  0
batch_normalization_34[0][0]
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_____
conv2d_35 (Conv2D)              (None, 17, 17, 128)  114688
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activation_34[0][0]
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batch_normalization_35 (BatchNo (None, 17, 17, 128)  384        conv2d_35[0][0]
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activation_35 (Activation)      (None, 17, 17, 128)  0
batch_normalization_35[0][0]
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conv2d_31 (Conv2D)              (None, 17, 17, 128)  98304      mixed3[0][0]
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conv2d_36 (Conv2D)              (None, 17, 17, 128)  114688
activation_35[0][0]
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batch_normalization_31 (BatchNo (None, 17, 17, 128)  384        conv2d_31[0][0]
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batch_normalization_36 (BatchNo (None, 17, 17, 128)  384        conv2d_36[0][0]
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------------------
activation_31 (Activation)      (None, 17, 17, 128)  0
batch_normalization_31[0][0]
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activation_36 (Activation)      (None, 17, 17, 128)  0
batch_normalization_36[0][0]
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------------------
conv2d_32 (Conv2D)              (None, 17, 17, 128)  114688
activation_31[0][0]
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------------------
conv2d_37 (Conv2D)              (None, 17, 17, 128)  114688
activation_36[0][0]
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batch_normalization_32 (BatchNo (None, 17, 17, 128)  384        conv2d_32[0][0]
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batch_normalization_37 (BatchNo (None, 17, 17, 128)  384        conv2d_37[0][0]
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------------------
activation_32 (Activation)      (None, 17, 17, 128)  0
batch_normalization_32[0][0]
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activation_37 (Activation)      (None, 17, 17, 128)  0
batch_normalization_37[0][0]
_____
------------------
average_pooling2d_3 (AveragePoo (None, 17, 17, 768)  0          mixed3[0][0]
_____
------------------
conv2d_30 (Conv2D)              (None, 17, 17, 192)  147456     mixed3[0][0]
_____
------------------
conv2d_33 (Conv2D)              (None, 17, 17, 192)  172032
activation_32[0][0]
_____
------------------
conv2d_38 (Conv2D)              (None, 17, 17, 192)  172032
activation_37[0][0]
_____
------------------
conv2d_39 (Conv2D)              (None, 17, 17, 192)  147456
average_pooling2d_3[0][0]
_____
------------------
batch_normalization_30 (BatchNo (None, 17, 17, 192)  576        conv2d_30[0][0]
_____
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batch_normalization_33 (BatchNo (None, 17, 17, 192)  576        conv2d_33[0][0]
_____
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batch_normalization_38 (BatchNo (None, 17, 17, 192)  576        conv2d_38[0][0]
_____
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batch_normalization_39 (BatchNo (None, 17, 17, 192)  576        conv2d_39[0][0]
_____
------------------
activation_30 (Activation)      (None, 17, 17, 192)  0
batch_normalization_30[0][0]
_____
------------------
activation_33 (Activation)      (None, 17, 17, 192)  0
batch_normalization_33[0][0]
_____
------------------
activation_38 (Activation)      (None, 17, 17, 192)  0
batch_normalization_38[0][0]
_____
------------------
activation_39 (Activation)      (None, 17, 17, 192)  0
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batch_normalization_39[0][0]
_____
_____
mixed4 (Concatenate)            (None, 17, 17, 768)  0
activation_30[0][0]
activation_33[0][0]
activation_38[0][0]
activation_39[0][0]
_____
_____
conv2d_44 (Conv2D)              (None, 17, 17, 160)  122880      mixed4[0][0]
_____
_____
batch_normalization_44 (BatchNo (None, 17, 17, 160)  480         conv2d_44[0][0]
_____
_____
activation_44 (Activation)      (None, 17, 17, 160)  0
batch_normalization_44[0][0]
_____
_____
conv2d_45 (Conv2D)              (None, 17, 17, 160)  179200
activation_44[0][0]
_____
_____
batch_normalization_45 (BatchNo (None, 17, 17, 160)  480         conv2d_45[0][0]
_____
_____
activation_45 (Activation)      (None, 17, 17, 160)  0
batch_normalization_45[0][0]
_____
_____
conv2d_41 (Conv2D)              (None, 17, 17, 160)  122880      mixed4[0][0]
_____
_____
conv2d_46 (Conv2D)              (None, 17, 17, 160)  179200
activation_45[0][0]
_____
_____
batch_normalization_41 (BatchNo (None, 17, 17, 160)  480         conv2d_41[0][0]
_____
_____
batch_normalization_46 (BatchNo (None, 17, 17, 160)  480         conv2d_46[0][0]
_____
_____
activation_41 (Activation)      (None, 17, 17, 160)  0
batch_normalization_41[0][0]
_____
_____
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activation_46 (Activation)      (None, 17, 17, 160)  0
batch_normalization_46[0][0]
_____
_____
conv2d_42 (Conv2D)              (None, 17, 17, 160)  179200
activation_41[0][0]
_____
_____
conv2d_47 (Conv2D)              (None, 17, 17, 160)  179200
activation_46[0][0]
_____
_____
batch_normalization_42 (BatchNo (None, 17, 17, 160)  480       conv2d_42[0][0]
_____
_____
batch_normalization_47 (BatchNo (None, 17, 17, 160)  480       conv2d_47[0][0]
_____
_____
activation_42 (Activation)      (None, 17, 17, 160)  0
batch_normalization_42[0][0]
_____
_____
activation_47 (Activation)      (None, 17, 17, 160)  0
batch_normalization_47[0][0]
_____
_____
average_pooling2d_4 (AveragePoo (None, 17, 17, 768)  0         mixed4[0][0]
_____
_____
conv2d_40 (Conv2D)              (None, 17, 17, 192)  147456    mixed4[0][0]
_____
_____
conv2d_43 (Conv2D)              (None, 17, 17, 192)  215040
activation_42[0][0]
_____
_____
conv2d_48 (Conv2D)              (None, 17, 17, 192)  215040
activation_47[0][0]
_____
_____
conv2d_49 (Conv2D)              (None, 17, 17, 192)  147456
average_pooling2d_4[0][0]
_____
_____
batch_normalization_40 (BatchNo (None, 17, 17, 192)  576       conv2d_40[0][0]
_____
_____
batch_normalization_43 (BatchNo (None, 17, 17, 192)  576       conv2d_43[0][0]
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batch_normalization_48 (BatchNo (None, 17, 17, 192)  576         conv2d_48[0][0]
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------------------
batch_normalization_49 (BatchNo (None, 17, 17, 192)  576         conv2d_49[0][0]
--------------------------------------------------------------------------------
------------------
activation_40 (Activation)      (None, 17, 17, 192)  0
batch_normalization_40[0][0]
--------------------------------------------------------------------------------
------------------
activation_43 (Activation)      (None, 17, 17, 192)  0
batch_normalization_43[0][0]
--------------------------------------------------------------------------------
------------------
activation_48 (Activation)      (None, 17, 17, 192)  0
batch_normalization_48[0][0]
--------------------------------------------------------------------------------
------------------
activation_49 (Activation)      (None, 17, 17, 192)  0
batch_normalization_49[0][0]
--------------------------------------------------------------------------------
------------------
mixed5 (Concatenate)            (None, 17, 17, 768)  0
activation_40[0][0]
activation_43[0][0]
activation_48[0][0]
activation_49[0][0]
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------------------
conv2d_54 (Conv2D)              (None, 17, 17, 160)  122880      mixed5[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_54 (BatchNo (None, 17, 17, 160)  480         conv2d_54[0][0]
--------------------------------------------------------------------------------
------------------
activation_54 (Activation)      (None, 17, 17, 160)  0
batch_normalization_54[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_55 (Conv2D)              (None, 17, 17, 160)  179200
activation_54[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_55 (BatchNo (None, 17, 17, 160)  480         conv2d_55[0][0]
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activation_55 (Activation)       (None, 17, 17, 160)   0          batch_normalization_55[0][0]
_____
conv2d_51 (Conv2D)               (None, 17, 17, 160)   122880     mixed5[0][0]
_____
conv2d_56 (Conv2D)               (None, 17, 17, 160)   179200     activation_55[0][0]
_____
batch_normalization_51 (BatchNo  (None, 17, 17, 160)   480        conv2d_51[0][0]
_____
batch_normalization_56 (BatchNo  (None, 17, 17, 160)   480        conv2d_56[0][0]
_____
activation_51 (Activation)       (None, 17, 17, 160)   0          batch_normalization_51[0][0]
_____
activation_56 (Activation)       (None, 17, 17, 160)   0          batch_normalization_56[0][0]
_____
conv2d_52 (Conv2D)               (None, 17, 17, 160)   179200     activation_51[0][0]
_____
conv2d_57 (Conv2D)               (None, 17, 17, 160)   179200     activation_56[0][0]
_____
batch_normalization_52 (BatchNo  (None, 17, 17, 160)   480        conv2d_52[0][0]
_____
batch_normalization_57 (BatchNo  (None, 17, 17, 160)   480        conv2d_57[0][0]
_____
activation_52 (Activation)       (None, 17, 17, 160)   0          batch_normalization_52[0][0]
_____
activation_57 (Activation)       (None, 17, 17, 160)   0          batch_normalization_57[0][0]
_____
average_pooling2d_5 (AveragePoo  (None, 17, 17, 768)   0          mixed5[0][0]
```

```
--------------------------------------------------------------------------------
------------------
conv2d_50 (Conv2D)            (None, 17, 17, 192)  147456     mixed5[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_53 (Conv2D)            (None, 17, 17, 192)  215040
activation_52[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_58 (Conv2D)            (None, 17, 17, 192)  215040
activation_57[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_59 (Conv2D)            (None, 17, 17, 192)  147456
average_pooling2d_5[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_50 (BatchNo (None, 17, 17, 192)  576       conv2d_50[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_53 (BatchNo (None, 17, 17, 192)  576       conv2d_53[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_58 (BatchNo (None, 17, 17, 192)  576       conv2d_58[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_59 (BatchNo (None, 17, 17, 192)  576       conv2d_59[0][0]
--------------------------------------------------------------------------------
------------------
activation_50 (Activation)    (None, 17, 17, 192)  0
batch_normalization_50[0][0]
--------------------------------------------------------------------------------
------------------
activation_53 (Activation)    (None, 17, 17, 192)  0
batch_normalization_53[0][0]
--------------------------------------------------------------------------------
------------------
activation_58 (Activation)    (None, 17, 17, 192)  0
batch_normalization_58[0][0]
--------------------------------------------------------------------------------
------------------
activation_59 (Activation)    (None, 17, 17, 192)  0
batch_normalization_59[0][0]
--------------------------------------------------------------------------------
------------------
mixed6 (Concatenate)          (None, 17, 17, 768)  0
activation_50[0][0]
activation_53[0][0]
```

```
                                  activation_58[0][0]
                                  activation_59[0][0]
_____
_____
conv2d_64 (Conv2D)              (None, 17, 17, 192)  147456     mixed6[0][0]
_____
_____
batch_normalization_64 (BatchNo (None, 17, 17, 192)  576        conv2d_64[0][0]
_____
_____
activation_64 (Activation)      (None, 17, 17, 192)  0
batch_normalization_64[0][0]
_____
_____
conv2d_65 (Conv2D)              (None, 17, 17, 192)  258048
activation_64[0][0]
_____
_____
batch_normalization_65 (BatchNo (None, 17, 17, 192)  576        conv2d_65[0][0]
_____
_____
activation_65 (Activation)      (None, 17, 17, 192)  0
batch_normalization_65[0][0]
_____
_____
conv2d_61 (Conv2D)              (None, 17, 17, 192)  147456     mixed6[0][0]
_____
_____
conv2d_66 (Conv2D)              (None, 17, 17, 192)  258048
activation_65[0][0]
_____
_____
batch_normalization_61 (BatchNo (None, 17, 17, 192)  576        conv2d_61[0][0]
_____
_____
batch_normalization_66 (BatchNo (None, 17, 17, 192)  576        conv2d_66[0][0]
_____
_____
activation_61 (Activation)      (None, 17, 17, 192)  0
batch_normalization_61[0][0]
_____
_____
activation_66 (Activation)      (None, 17, 17, 192)  0
batch_normalization_66[0][0]
_____
_____
conv2d_62 (Conv2D)              (None, 17, 17, 192)  258048
activation_61[0][0]
```

```
--------------------------------------------------------------------------------
------------------
conv2d_67 (Conv2D)              (None, 17, 17, 192)  258048
activation_66[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_62 (BatchNo (None, 17, 17, 192)  576          conv2d_62[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_67 (BatchNo (None, 17, 17, 192)  576          conv2d_67[0][0]
--------------------------------------------------------------------------------
------------------
activation_62 (Activation)      (None, 17, 17, 192)  0
batch_normalization_62[0][0]
--------------------------------------------------------------------------------
------------------
activation_67 (Activation)      (None, 17, 17, 192)  0
batch_normalization_67[0][0]
--------------------------------------------------------------------------------
------------------
average_pooling2d_6 (AveragePoo (None, 17, 17, 768)  0            mixed6[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_60 (Conv2D)              (None, 17, 17, 192)  147456       mixed6[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_63 (Conv2D)              (None, 17, 17, 192)  258048
activation_62[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_68 (Conv2D)              (None, 17, 17, 192)  258048
activation_67[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_69 (Conv2D)              (None, 17, 17, 192)  147456
average_pooling2d_6[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_60 (BatchNo (None, 17, 17, 192)  576          conv2d_60[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_63 (BatchNo (None, 17, 17, 192)  576          conv2d_63[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_68 (BatchNo (None, 17, 17, 192)  576          conv2d_68[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_69 (BatchNo (None, 17, 17, 192)  576          conv2d_69[0][0]
```

```
----------------------------------------------------------------------
------------------
activation_60 (Activation)        (None, 17, 17, 192)   0
batch_normalization_60[0][0]
----------------------------------------------------------------------
------------------
activation_63 (Activation)        (None, 17, 17, 192)   0
batch_normalization_63[0][0]
----------------------------------------------------------------------
------------------
activation_68 (Activation)        (None, 17, 17, 192)   0
batch_normalization_68[0][0]
----------------------------------------------------------------------
------------------
activation_69 (Activation)        (None, 17, 17, 192)   0
batch_normalization_69[0][0]
----------------------------------------------------------------------
------------------
mixed7 (Concatenate)              (None, 17, 17, 768)   0
activation_60[0][0]
activation_63[0][0]
activation_68[0][0]
activation_69[0][0]
----------------------------------------------------------------------
------------------
conv2d_72 (Conv2D)                (None, 17, 17, 192)   147456     mixed7[0][0]
----------------------------------------------------------------------
------------------
batch_normalization_72 (BatchNo   (None, 17, 17, 192)   576        conv2d_72[0][0]
----------------------------------------------------------------------
------------------
activation_72 (Activation)        (None, 17, 17, 192)   0
batch_normalization_72[0][0]
----------------------------------------------------------------------
------------------
conv2d_73 (Conv2D)                (None, 17, 17, 192)   258048
activation_72[0][0]
----------------------------------------------------------------------
------------------
batch_normalization_73 (BatchNo   (None, 17, 17, 192)   576        conv2d_73[0][0]
----------------------------------------------------------------------
------------------
activation_73 (Activation)        (None, 17, 17, 192)   0
batch_normalization_73[0][0]
----------------------------------------------------------------------
------------------
conv2d_70 (Conv2D)                (None, 17, 17, 192)   147456     mixed7[0][0]
----------------------------------------------------------------------
------------------
```

```
-----------------
conv2d_74 (Conv2D)              (None, 17, 17, 192)  258048
activation_73[0][0]
_____
-----------------
batch_normalization_70 (BatchNo (None, 17, 17, 192)  576         conv2d_70[0][0]
_____
-----------------
batch_normalization_74 (BatchNo (None, 17, 17, 192)  576         conv2d_74[0][0]
_____
-----------------
activation_70 (Activation)      (None, 17, 17, 192)  0
batch_normalization_70[0][0]
_____
-----------------
activation_74 (Activation)      (None, 17, 17, 192)  0
batch_normalization_74[0][0]
_____
-----------------
conv2d_71 (Conv2D)              (None, 8, 8, 320)    552960
activation_70[0][0]
_____
-----------------
conv2d_75 (Conv2D)              (None, 8, 8, 192)    331776
activation_74[0][0]
_____
-----------------
batch_normalization_71 (BatchNo (None, 8, 8, 320)    960         conv2d_71[0][0]
_____
-----------------
batch_normalization_75 (BatchNo (None, 8, 8, 192)    576         conv2d_75[0][0]
_____
-----------------
activation_71 (Activation)      (None, 8, 8, 320)    0
batch_normalization_71[0][0]
_____
-----------------
activation_75 (Activation)      (None, 8, 8, 192)    0
batch_normalization_75[0][0]
_____
-----------------
max_pooling2d_3 (MaxPooling2D)  (None, 8, 8, 768)    0           mixed7[0][0]
_____
-----------------
mixed8 (Concatenate)            (None, 8, 8, 1280)   0
activation_71[0][0]
activation_75[0][0]
max_pooling2d_3[0][0]
```

```
--------------------------------------------------------------------------------
------------------
conv2d_80 (Conv2D)              (None, 8, 8, 448)    573440      mixed8[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_80 (BatchNo (None, 8, 8, 448)    1344        conv2d_80[0][0]
--------------------------------------------------------------------------------
------------------
activation_80 (Activation)      (None, 8, 8, 448)    0
batch_normalization_80[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_77 (Conv2D)              (None, 8, 8, 384)    491520      mixed8[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_81 (Conv2D)              (None, 8, 8, 384)    1548288
activation_80[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_77 (BatchNo (None, 8, 8, 384)    1152        conv2d_77[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_81 (BatchNo (None, 8, 8, 384)    1152        conv2d_81[0][0]
--------------------------------------------------------------------------------
------------------
activation_77 (Activation)      (None, 8, 8, 384)    0
batch_normalization_77[0][0]
--------------------------------------------------------------------------------
------------------
activation_81 (Activation)      (None, 8, 8, 384)    0
batch_normalization_81[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_78 (Conv2D)              (None, 8, 8, 384)    442368
activation_77[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_79 (Conv2D)              (None, 8, 8, 384)    442368
activation_77[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_82 (Conv2D)              (None, 8, 8, 384)    442368
activation_81[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_83 (Conv2D)              (None, 8, 8, 384)    442368
activation_81[0][0]
--------------------------------------------------------------------------------
------------------
```

```
------------------
average_pooling2d_7 (AveragePoo (None, 8, 8, 1280)   0           mixed8[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_76 (Conv2D)              (None, 8, 8, 320)    409600      mixed8[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_78 (BatchNo (None, 8, 8, 384)    1152        conv2d_78[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_79 (BatchNo (None, 8, 8, 384)    1152        conv2d_79[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_82 (BatchNo (None, 8, 8, 384)    1152        conv2d_82[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_83 (BatchNo (None, 8, 8, 384)    1152        conv2d_83[0][0]
--------------------------------------------------------------------------------
------------------
conv2d_84 (Conv2D)              (None, 8, 8, 192)    245760
average_pooling2d_7[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_76 (BatchNo (None, 8, 8, 320)    960         conv2d_76[0][0]
--------------------------------------------------------------------------------
------------------
activation_78 (Activation)      (None, 8, 8, 384)    0
batch_normalization_78[0][0]
--------------------------------------------------------------------------------
------------------
activation_79 (Activation)      (None, 8, 8, 384)    0
batch_normalization_79[0][0]
--------------------------------------------------------------------------------
------------------
activation_82 (Activation)      (None, 8, 8, 384)    0
batch_normalization_82[0][0]
--------------------------------------------------------------------------------
------------------
activation_83 (Activation)      (None, 8, 8, 384)    0
batch_normalization_83[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_84 (BatchNo (None, 8, 8, 192)    576         conv2d_84[0][0]
--------------------------------------------------------------------------------
------------------
activation_76 (Activation)      (None, 8, 8, 320)    0
batch_normalization_76[0][0]
--------------------------------------------------------------------------------
```

```
------------------
mixed9_0 (Concatenate)        (None, 8, 8, 768)    0
activation_78[0][0]
activation_79[0][0]
_____
------------------
concatenate (Concatenate)     (None, 8, 8, 768)    0
activation_82[0][0]
activation_83[0][0]
_____
------------------
activation_84 (Activation)    (None, 8, 8, 192)    0
batch_normalization_84[0][0]
_____
------------------
mixed9 (Concatenate)          (None, 8, 8, 2048)   0
activation_76[0][0]

                                                        mixed9_0[0][0]

concatenate[0][0]
activation_84[0][0]
_____
------------------
conv2d_89 (Conv2D)            (None, 8, 8, 448)    917504     mixed9[0][0]
_____
------------------
batch_normalization_89 (BatchNo (None, 8, 8, 448)  1344       conv2d_89[0][0]
_____
------------------
activation_89 (Activation)    (None, 8, 8, 448)    0
batch_normalization_89[0][0]
_____
------------------
conv2d_86 (Conv2D)            (None, 8, 8, 384)    786432     mixed9[0][0]
_____
------------------
conv2d_90 (Conv2D)            (None, 8, 8, 384)    1548288
activation_89[0][0]
_____
------------------
batch_normalization_86 (BatchNo (None, 8, 8, 384)  1152       conv2d_86[0][0]
_____
------------------
batch_normalization_90 (BatchNo (None, 8, 8, 384)  1152       conv2d_90[0][0]
_____
------------------
activation_86 (Activation)    (None, 8, 8, 384)    0
batch_normalization_86[0][0]
_____
```

```
------------------
activation_90 (Activation)        (None, 8, 8, 384)    0
batch_normalization_90[0][0]
_____
------------------
conv2d_87 (Conv2D)                (None, 8, 8, 384)    442368
activation_86[0][0]
_____
------------------
conv2d_88 (Conv2D)                (None, 8, 8, 384)    442368
activation_86[0][0]
_____
------------------
conv2d_91 (Conv2D)                (None, 8, 8, 384)    442368
activation_90[0][0]
_____
------------------
conv2d_92 (Conv2D)                (None, 8, 8, 384)    442368
activation_90[0][0]
_____
------------------
average_pooling2d_8 (AveragePoo   (None, 8, 8, 2048)   0           mixed9[0][0]
_____
------------------
conv2d_85 (Conv2D)                (None, 8, 8, 320)    655360      mixed9[0][0]
_____
------------------
batch_normalization_87 (BatchNo   (None, 8, 8, 384)    1152        conv2d_87[0][0]
_____
------------------
batch_normalization_88 (BatchNo   (None, 8, 8, 384)    1152        conv2d_88[0][0]
_____
------------------
batch_normalization_91 (BatchNo   (None, 8, 8, 384)    1152        conv2d_91[0][0]
_____
------------------
batch_normalization_92 (BatchNo   (None, 8, 8, 384)    1152        conv2d_92[0][0]
_____
------------------
conv2d_93 (Conv2D)                (None, 8, 8, 192)    393216
average_pooling2d_8[0][0]
_____
------------------
batch_normalization_85 (BatchNo   (None, 8, 8, 320)    960         conv2d_85[0][0]
_____
------------------
activation_87 (Activation)        (None, 8, 8, 384)    0
batch_normalization_87[0][0]
```

```
--------------------------------------------------------------------------------
------------------
activation_88 (Activation)       (None, 8, 8, 384)    0
batch_normalization_88[0][0]
--------------------------------------------------------------------------------
------------------
activation_91 (Activation)       (None, 8, 8, 384)    0
batch_normalization_91[0][0]
--------------------------------------------------------------------------------
------------------
activation_92 (Activation)       (None, 8, 8, 384)    0
batch_normalization_92[0][0]
--------------------------------------------------------------------------------
------------------
batch_normalization_93 (BatchNo (None, 8, 8, 192)    576       conv2d_93[0][0]
--------------------------------------------------------------------------------
------------------
activation_85 (Activation)       (None, 8, 8, 320)    0
batch_normalization_85[0][0]
--------------------------------------------------------------------------------
------------------
mixed9_1 (Concatenate)           (None, 8, 8, 768)    0
activation_87[0][0]
activation_88[0][0]
--------------------------------------------------------------------------------
------------------
concatenate_1 (Concatenate)      (None, 8, 8, 768)    0
activation_91[0][0]
activation_92[0][0]
--------------------------------------------------------------------------------
------------------
activation_93 (Activation)       (None, 8, 8, 192)    0
batch_normalization_93[0][0]
--------------------------------------------------------------------------------
------------------
mixed10 (Concatenate)            (None, 8, 8, 2048)   0
activation_85[0][0]
                                                                mixed9_1[0][0]
concatenate_1[0][0]
activation_93[0][0]
--------------------------------------------------------------------------------
------------------
avg_pool (GlobalAveragePooling2 (None, 2048)         0         mixed10[0][0]
--------------------------------------------------------------------------------
------------------
predictions (Dense)              (None, 1000)         2049000   avg_pool[0][0]
================================================================================
================
```

```
Total params: 23,851,784
Trainable params: 23,817,352
Non-trainable params: 34,432

_____

_____
None
```

1.3   Prepare image

You can change it to any image you want.

```python
[3]: ## Path of Input Image
     dir_path = './examples'
     img_name = os.listdir('./examples')[3]
     img_path = dir_path + '/' + img_name
```

```python
[4]: ## Prepare Input Image
     Xi = skimage.io.imread(img_path)
     origianl_img = Xi
     origianl_img_size = origianl_img.shape
     print(origianl_img_size)

     ## Reshape input image
     Xi = skimage.transform.resize(Xi, input_size)
     print(Xi.shape)
     Xi = (Xi - 0.5) *2    # Inception pre-processing
```

```
(486, 729, 3)
(299, 299, 3)
```

```python
[5]: ## Visualization input image
     fig, ax = plt.subplots(nrows=1, ncols=1, sharex=True, sharey=True)
     skimage.io.imshow(Xi/2 + 0.5)   # Show image before inception preprocessing
     ax.axis('off')
     plt.show()
```

```
[6]:  ## Get array of input image
      img_array = Xi[np.newaxis, :, :, :]
      img_array = img_array.astype('float32')

      ## Prediction input image & Print what the top predicted class is
      preds = model.predict(img_array)
      print(decode_predictions(preds)[0])    # Top 5 classes
      interested_class_order = 0   # The class with the 'interested_class_order'-th⌋
       ↪highest confidence

      ## Index of the class of interest
      top_pred_classes_index = preds[0].argsort()[-5:][::-1]
      top_pred_classes_index    # Index of top 5 classes
      interested_class_index = top_pred_classes_index[interested_class_order]    #⌋
       ↪Index of the class of interest
```

```
[('n02110958', 'pug', 0.15104042), ('n02123597', 'Siamese_cat', 0.061423033),
('n02808304', 'bath_towel', 0.05276003), ('n02124075', 'Egyptian_cat',
0.031069592), ('n02108422', 'bull_mastiff', 0.014700278)]
```

1.4 The Pixab-CAM algorithm

```
[7]:  ## Get index for interested class
      cls = interested_class_index

      ## Create a model that maps the input image to the activations of the last conv⌋
       ↪layer
      last_conv_layer = model.get_layer(last_conv_layer_name)
      last_conv_layer_model = tf.keras.Model(model.inputs, last_conv_layer.output)

      ## Create a model that maps the activations of the last conv layer to the final⌋
       ↪class predictions
      classifier_input = tf.keras.Input(shape=last_conv_layer.output.shape[1:])
      x = classifier_input
      for layer_name in classifier_layer_names:
          x = model.get_layer(layer_name)(x)
      classifier_model = tf.keras.Model(classifier_input, x)

      ## Compute the gradient of the top predicted class for our input image with⌋
       ↪respect to the activations of the last conv layer
      with tf.GradientTape() as tape:
          # Compute activations of the last conv layer and make the tape watch it
          last_conv_layer_output = last_conv_layer_model(img_array)
          tape.watch(last_conv_layer_output)
```

```python
    # Compute class predictions
    preds = classifier_model(last_conv_layer_output)
    top_pred_index = tf.argmax(preds[0])
    #top_class_channel = preds[:, top_pred_index]
    top_class_channel = preds[:, cls]


last_conv_layer_output = last_conv_layer_output.numpy()


## Activation Tensor
activations = last_conv_layer_output.copy()
last_layer_activation = activations[-1]


activation = last_layer_activation
activation = np.expand_dims(activation, axis=0)


## window_size = 1 X 1
# ablation box (deletion perspective)
inv_identity = (1 - np.identity(last_layer_activation.shape[0] *␣
 ↪last_layer_activation.shape[1]))
inv_identity = inv_identity.reshape(last_layer_activation.shape[0] *␣
 ↪last_layer_activation.shape[1], last_layer_activation.shape[0],␣
 ↪last_layer_activation.shape[1])


activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)
values = prediction[:, cls].numpy().reshape(last_layer_activation.shape[0],␣
 ↪last_layer_activation.shape[0])
values1 = values


# reverse ablation box (preservation perspective)
identity = 1 - inv_identity


activation_tensor = activation * identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)
values = prediction[:, cls].numpy().reshape(last_layer_activation.shape[0],␣
 ↪last_layer_activation.shape[0])
reverse_values1 = values


## window_size = 2 X 1
# ablation box (deletion perspective)
window_size = 2 ; padding = 1
inv_identity = (1 - np.identity((last_layer_activation.shape[0] + (2 * padding))␣
 ↪* (last_layer_activation.shape[1] + (2 * padding))))
inv_identity = inv_identity.reshape((last_layer_activation.shape[0] + (2 *␣
 ↪padding)) * (last_layer_activation.shape[1] + (2 * padding)),␣
 ↪(last_layer_activation.shape[0] + (2 * padding)), (last_layer_activation.
 ↪shape[1] + (2 * padding)))
```

```python
index_matrix = np.arange((activation.shape[1] + (2 * padding)) * (activation.
 ↪shape[2] + (2 * padding))).reshape((activation.shape[1] + (2 * padding)),␣
 ↪(activation.shape[2] + (2 * padding)))
index_matrix[:(activation.shape[1] + (2 * padding)) - (window_size - 1), :
 ↪(activation.shape[2] + (2 * padding)) - (window_size - 1)] = 0
inv_identity = np.delete(inv_identity, np.unique(index_matrix)[1:], 0)  # delete␣
 ↪second row of A

zero_loc = np.where(inv_identity == 0)
set_zero = (zero_loc[0], zero_loc[1] + padding, zero_loc[2])
inv_identity[set_zero] = 0

inv_identity = inv_identity[:, padding:activation.shape[1] + padding, padding:
 ↪activation.shape[2] + padding]
inv_identity = np.delete(inv_identity, np.where(np.sum(1 - inv_identity,␣
 ↪axis=(1, 2)) == 0)[0], 0)  # delete second row of A
identity = 1 - inv_identity

activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)

values = prediction[:, cls].numpy()[:, np.newaxis, np.newaxis]
values = identity * values
values = values.sum(axis=0) / identity.sum(axis=0)
values2 = values

# reverse ablation box (preservation perspective)
inv_identity, identity = identity, inv_identity

activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)

values = prediction[:, cls].numpy()[:, np.newaxis, np.newaxis]
values = identity * values
values = values.sum(axis=0) / identity.sum(axis=0)
reverse_values2 = values

## window_size = 1 X 2
# ablation box (deletion perspective)
window_size = 2 ; padding = 1
inv_identity = (1 - np.identity((last_layer_activation.shape[0] + (2 * padding))␣
 ↪* (last_layer_activation.shape[1] + (2 * padding))))
```

```python
inv_identity = inv_identity.reshape((last_layer_activation.shape[0] + (2 *
  padding)) * (last_layer_activation.shape[1] + (2 * padding)),
  (last_layer_activation.shape[0] + (2 * padding)), (last_layer_activation.
  shape[1] + (2 * padding)))

index_matrix = np.arange((activation.shape[1] + (2 * padding)) * (activation.
  shape[2] + (2 * padding))).reshape((activation.shape[1] + (2 * padding)),
  (activation.shape[2] + (2 * padding)))
index_matrix[:(activation.shape[1] + (2 * padding)) - (window_size - 1), :
  (activation.shape[2] + (2 * padding)) - (window_size - 1)] = 0
inv_identity = np.delete(inv_identity, np.unique(index_matrix)[1:], 0)  # delete
  second row of A

zero_loc = np.where(inv_identity == 0)
set_zero = (zero_loc[0], zero_loc[1], zero_loc[2] + padding)
inv_identity[set_zero] = 0

inv_identity = inv_identity[:, padding:activation.shape[1] + padding, padding:
  activation.shape[2] + padding]
inv_identity = np.delete(inv_identity, np.where(np.sum(1 - inv_identity,
  axis=(1, 2)) == 0)[0], 0)  # delete second row of A
identity = 1 - inv_identity

activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)

values = prediction[:, cls].numpy()[:, np.newaxis, np.newaxis]
values = identity * values
values = values.sum(axis=0) / identity.sum(axis=0)
values3 = values

# reverse ablation box (preservation perspective)
inv_identity, identity = identity, inv_identity

activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)

values = prediction[:, cls].numpy()[:, np.newaxis, np.newaxis]
values = identity * values
values = values.sum(axis=0) / identity.sum(axis=0)
reverse_values3 = values

## window_size = 2 X 2
# ablation box (deletion perspective)
window_size = 2 ; padding = 1
```

```python
inv_identity = (1 - np.identity((last_layer_activation.shape[0] + (2 * padding))
 * (last_layer_activation.shape[1] + (2 * padding)))))
inv_identity = inv_identity.reshape((last_layer_activation.shape[0] + (2 *
 padding)) * (last_layer_activation.shape[1] + (2 * padding)),
 (last_layer_activation.shape[0] + (2 * padding)), (last_layer_activation.
 shape[1] + (2 * padding)))

index_matrix = np.arange((activation.shape[1] + (2 * padding)) * (activation.
 shape[2] + (2 * padding))).reshape((activation.shape[1] + (2 * padding)),
 (activation.shape[2] + (2 * padding)))
index_matrix[:(activation.shape[1] + (2 * padding)) - (window_size - 1), :
 (activation.shape[2] + (2 * padding)) - (window_size - 1)] = 0
inv_identity = np.delete(inv_identity, np.unique(index_matrix)[1:], 0)  # delete
 second row of A

zero_loc = np.where(inv_identity == 0)
for p, q in list(combinations_with_replacement(range(window_size), 2))[1:]:
    set_zero = (zero_loc[0], zero_loc[1] + p, zero_loc[2] + q)
    inv_identity[set_zero] = 0
    if p != q:
        set_zero = (zero_loc[0], zero_loc[1] + q, zero_loc[2] + p)
        inv_identity[set_zero] = 0

inv_identity = inv_identity[:, padding:activation.shape[1] + padding, padding:
 activation.shape[2] + padding]
identity = 1 - inv_identity

activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)

values = prediction[:, cls].numpy()[:, np.newaxis, np.newaxis]
values = identity * values
values = values.sum(axis=0) / identity.sum(axis=0)
values4 = values

# reverse ablation box (preservation perspective)
inv_identity, identity = identity, inv_identity

activation_tensor = activation * inv_identity[..., np.newaxis]
prediction = classifier_model(activation_tensor)

values = prediction[:, cls].numpy()[:, np.newaxis, np.newaxis]
values = identity * values
values = values.sum(axis=0) / identity.sum(axis=0)
reverse_values4 = values
```

```
## average over all ablation boxes of each perspective
values = (values1 + values2 + values3 + values4) / 4
reverse_values = (reverse_values1 + reverse_values2 + reverse_values3 +␣
 ↪reverse_values4) / 4


## weight ratio
aero = preds.numpy()[:, cls][:, np.newaxis]
weight_ratio = ((aero - values) / aero)


## reverse weight ratio
zero_tensor = np.zeros(last_conv_layer_output.shape)
reverse_preds = classifier_model(zero_tensor)


reverse_aero = reverse_preds.numpy()[:, cls][:, np.newaxis]
reverse_weight_ratio = ((reverse_values - reverse_aero) / reverse_aero)


## heapmap
heatmap = weight_ratio * reverse_weight_ratio
heatmap = np.maximum(heatmap, 0) / np.max(heatmap)
```

1.5 Generate visual explanation map of Pixab-CAM

```
[8]: salience = skimage.transform.resize(heatmap, (299, 299))
     plt.figure(1)
     skimage.io.imshow(Xi/2 + 0.5)
     plt.imshow(salience, cmap="jet", alpha=0.75)
     plt.axis('off')
     plt.show()
```