gradCAM_tensorflow_ResNet101_demo

November 13, 2018

1 GradCAM Visualization Demo with ResNet101

Requirement:

- GPU Memory: 6GB or higher

```
In [1]: import numpy as np
        import tensorflow as tf
        from keras.applications.resnet50 import ResNet50
        from keras.applications.resnet50    import decode_predictions
        import os
        from tensorflow.python.framework import ops
        from tensorflow.python.ops import gen_nn_ops
        import matplotlib.pyplot as plt
        from keras.preprocessing.image import load_img
        from keras.preprocessing.image import img_to_array

        import numpy as np

        from tensorflow.contrib.slim.python.slim.nets  import resnet_v1
        slim = tf.contrib.slim

        import utils

        from tensorflow.python.framework import ops
        from tensorflow.python.ops import gen_nn_ops
```

```
C:\Users\wukai\Anaconda3\lib\site-packages\h5py\__init__.py:36: FutureWarning: Conversion of tl
  from ._conv import register_converters as _register_converters
Using TensorFlow backend.
```

```
In [2]: # Replace vanila relu to guided relu to get guided backpropagation.

        @ops.RegisterGradient("GuidedRelu")
        def _GuidedReluGrad(op, grad):
            return tf.where(0. < grad, gen_nn_ops.relu_grad(grad, op.outputs[0]), tf.zeros(grad
In [3]: folder = './input/'
        filenames   = os.listdir(folder)
        line_number = len(filenames)
        print(filenames,line_number)
        batch_img,batch_label = [],[]
        resnet50 = ResNet50(weights='imagenet')
        for line, filename in enumerate(filenames):
            raw_image  = load_img(folder + filename,target_size=(224, 224))
            batch = img_to_array(raw_image)
            batch = batch.reshape((1, 224, 224, 3))
            pred = resnet50.predict(batch)
            index = np.argmax(pred)
            label = decode_predictions(pred)[:3]
            # Now making batch image for Grad-CAM
            img = utils.load_image(folder + filename,normalize=False)
            batch_im = img.reshape((1, 224, 224, 3))
            batch_img.append(batch_im)
            batch_label.append(np.array([1 if i == index else 0 for i in range(1000)]).reshape
        batch_size = len(batch_img)
        batch_img = np.concatenate(tuple(batch_img),0)
        batch_label = np.concatenate(tuple(batch_label),0)

        print(batch_img.shape)
```

```
['agama.jpg', 'agama_FGSM.jpg', 'dog.jpg', 'dog_FGSM.jpg', 'magpie.jpg', 'magpie_FGSM.jpg', 'pa


C:\Users\wukai\Anaconda3\lib\site-packages\skimage\transform\_warps.py:84: UserWarning: The de
  warn("The default mode, 'constant', will be changed to 'reflect' in "


(10, 224, 224, 3)
```

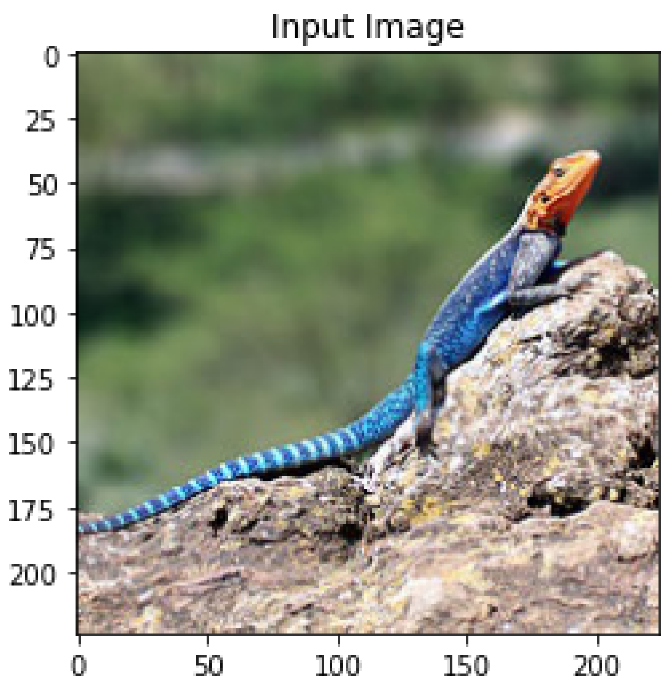
```
In [4]: %reload_ext autoreload
        %autoreload 2
        %matplotlib inline




        eval_graph = tf.Graph()
        with eval_graph.as_default():
            with eval_graph.gradient_override_map({'Relu': 'GuidedRelu'}):
                images = tf.placeholder("float", [batch_size, 224, 224, 3])
                labels = tf.placeholder(tf.float32, [batch_size, 1000])

                preprocessed_images = utils.resnet_preprocess(images)

                with slim.arg_scope(resnet_v1.resnet_arg_scope()):
```

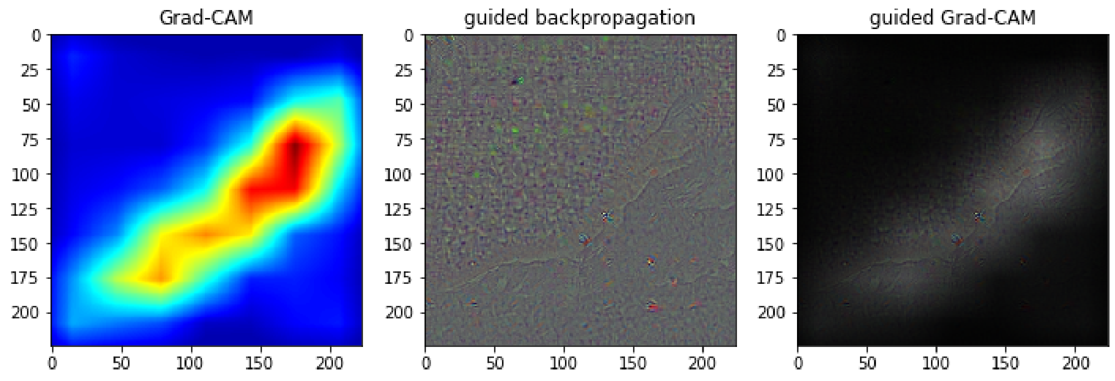
```
    with slim.arg_scope([slim.batch_norm], is_training=False):
        # is_training=False means batch-norm is not in training mode. Fixing b
        # net is logit for resnet_v1. See is_training messing up issue: https:/
        net, end_points = resnet_v1.resnet_v1_101(preprocessed_images, 1000)
prob = end_points['predictions'] # after softmax

cost = (-1) * tf.reduce_sum(tf.multiply(labels, tf.log(prob)), axis=1)
print('cost:', cost)
y_c = tf.reduce_sum(tf.multiply(net, labels), axis=1)
print('y_c:', y_c)

# Get last convolutional layer gradient for generating gradCAM visualization
# print('endpoints:', end_points.keys())
target_conv_layer = end_points['resnet_v1_101/block4/unit_2/bottleneck_v1']
target_conv_layer_grad = tf.gradients(y_c, target_conv_layer)[0]

# Guided backpropagtion back to input layer
gb_grad = tf.gradients(cost, images)[0]

init = tf.global_variables_initializer()

# Load resnet v1 weights

# latest_checkpoint = tf.train.latest_checkpoint("model/resnet_v1_50.ckpt")
latest_checkpoint = "model/resnet_v1_101.ckpt"
## Optimistic restore.
reader = tf.train.NewCheckpointReader(latest_checkpoint)
saved_shapes = reader.get_variable_to_shape_map()
variables_to_restore = tf.global_variables()
for var in variables_to_restore:
  if not var.name.split(':')[0] in saved_shapes:
    print("WARNING. Saved weight not exists in checkpoint. Init var:", var.name
  else:
    # print("Load saved weight:", var.name)
    pass

var_names = sorted([(var.name, var.name.split(':')[0]) for var in variables_to_
        if var.name.split(':')[0] in saved_shapes])
restore_vars = []
with tf.variable_scope('', reuse=True):
    for var_name, saved_var_name in var_names:
        try:
            curr_var = tf.get_variable(saved_var_name)
            var_shape = curr_var.get_shape().as_list()
            if var_shape == saved_shapes[saved_var_name]:
                # print("restore var:", saved_var_name)
                restore_vars.append(curr_var)
        except ValueError:
```

```
                        print("Ignore due to ValueError on getting var:", saved_var_name)
                saver = tf.train.Saver(restore_vars)



        # Run tensorflow

        with tf.Session(graph=eval_graph) as sess:
            sess.run(init)
            # sess.run(tf.local_variables_initializer())
            saver.restore(sess, latest_checkpoint)

            prob = sess.run(prob, feed_dict={images: batch_img})

            # gb_grad_value, target_conv_layer_value, target_conv_layer_grad_value = sess.run(
            gb_grad_value, target_conv_layer_value, target_conv_layer_grad_value = sess.run([gb

            for i in range(batch_size):
                # print('See visualization of below category')
                # utils.print_prob(batch_label[i], './synset.txt')
                utils.print_prob_res(prob[i], './synset.txt')
                # print('gb_grad_value[i]:', gb_grad_value[i])
                # print('gb_grad_value[i] shape:', gb_grad_value[i].shape)
                utils.visualize(batch_img[i], target_conv_layer_value[i], target_conv_layer_gra
```

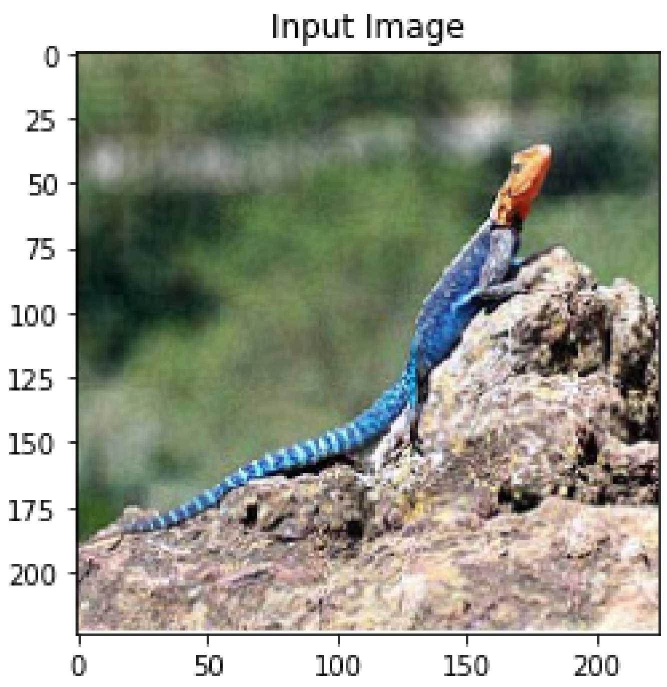
```
cost: Tensor("mul_1:0", shape=(10, 10, 1000), dtype=float32)
y_c: Tensor("Sum_1:0", shape=(10, 10, 1000), dtype=float32)
INFO:tensorflow:Restoring parameters from model/resnet_v1_101.ckpt
Top1:  n01687978 agama 0.9972568
Top5:  [('n01687978 agama', 0.9972568), ('n01685808 whiptail, whiptail lizard', 0.000496891),
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```

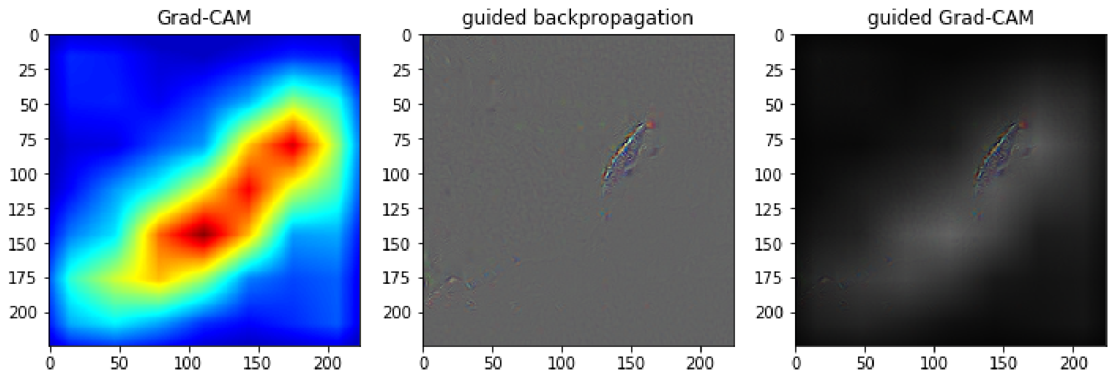
```
C:\Users\wukai\Anaconda3\lib\site-packages\skimage\transform\_warps.py:84: UserWarning: The de
  warn("The default mode, 'constant', will be changed to 'reflect' in "
```



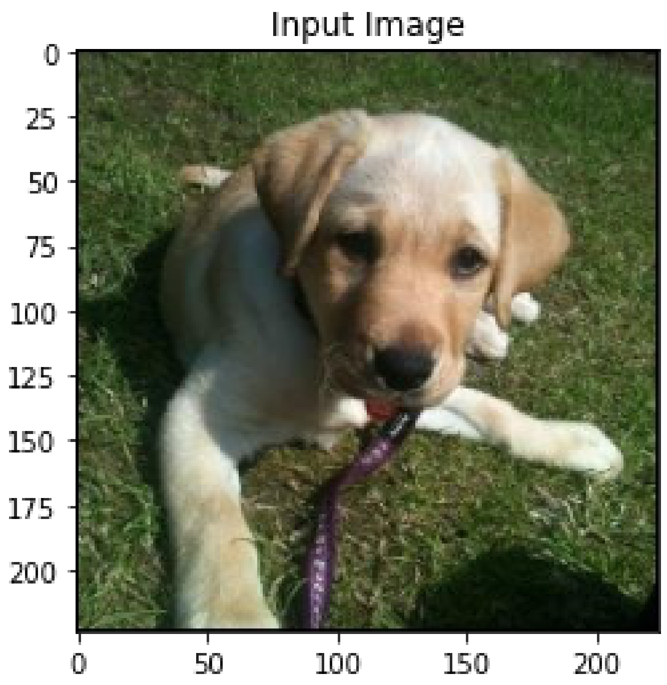


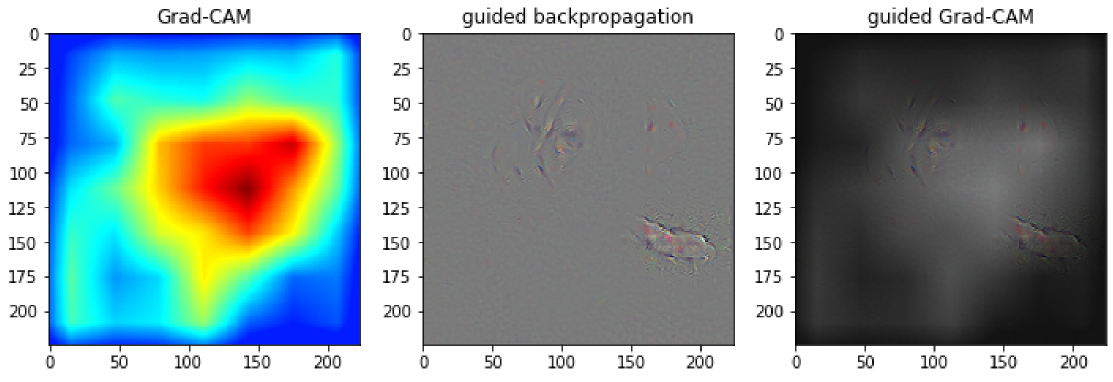
```
Top1:  n01687978 agama 0.9842128
Top5:  [('n01687978 agama', 0.9842128), ('n01685808 whiptail, whiptail lizard', 0.0026560833),
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



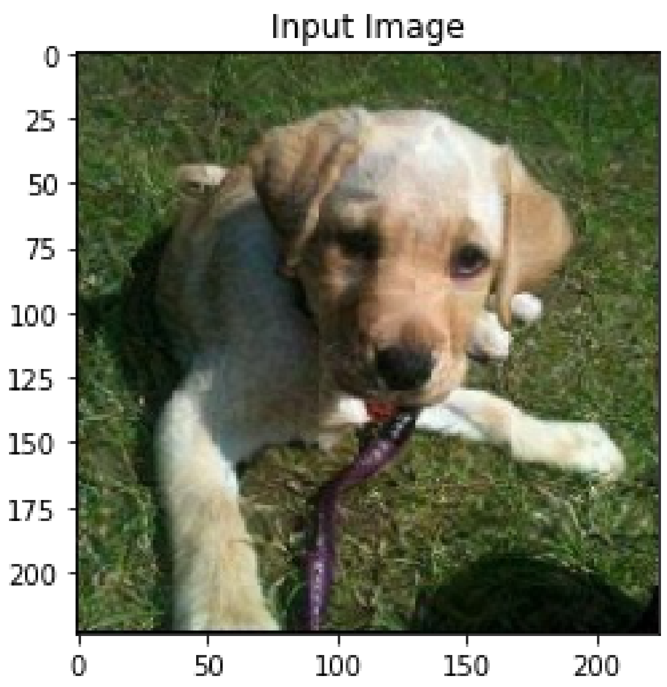


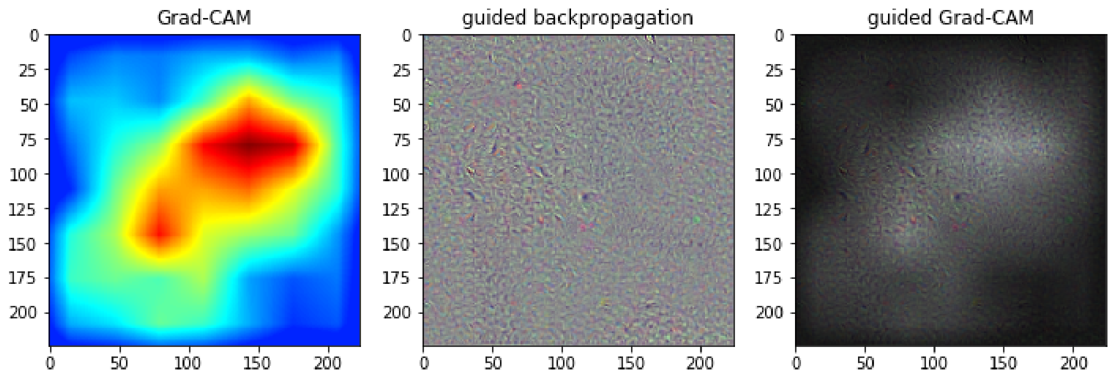
```
Top1:  n02099712 Labrador retriever 0.69541574
Top5:  [('n02099712 Labrador retriever', 0.69541574), ('n02099601 golden retriever', 0.1390880
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



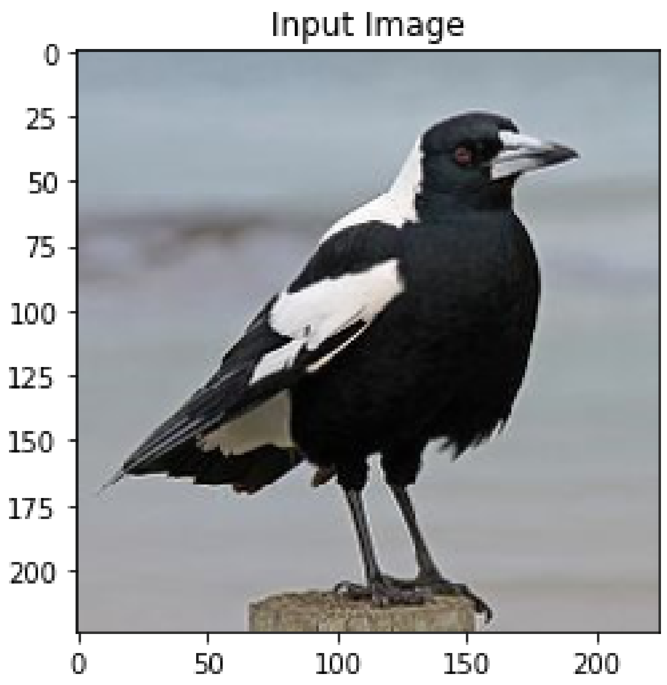


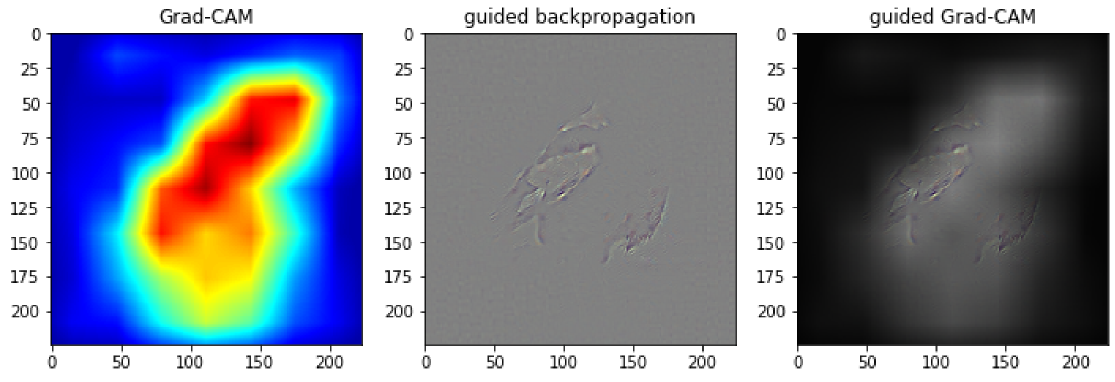
```
Top1:  n02099849 Chesapeake Bay retriever 0.43797117
Top5:  [('n02099849 Chesapeake Bay retriever', 0.43797117), ('n02099712 Labrador retriever', 0
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



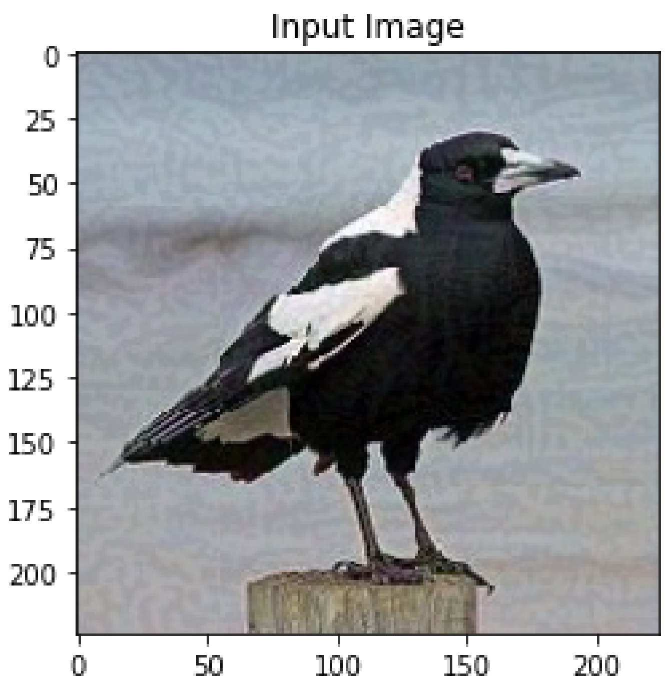


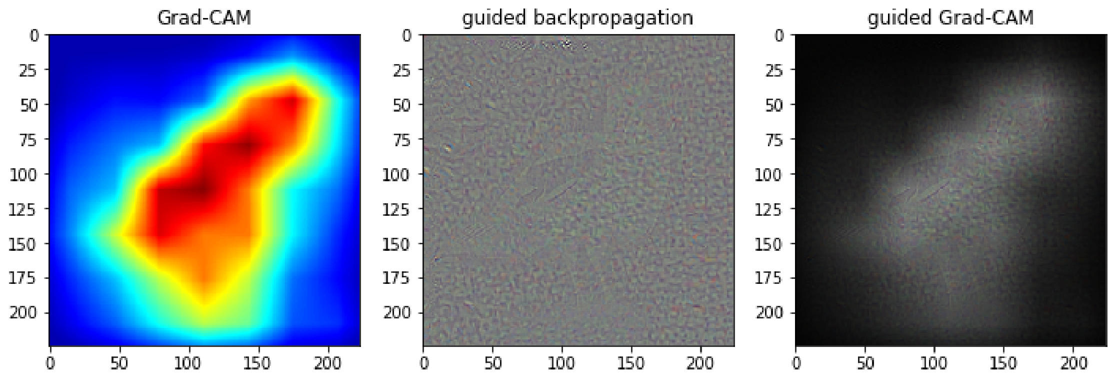
```
Top1:  n01582220 magpie 0.9914288
Top5:  [('n01582220 magpie', 0.9914288), ('n01795545 black grouse', 0.0022710257), ('n02037110
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



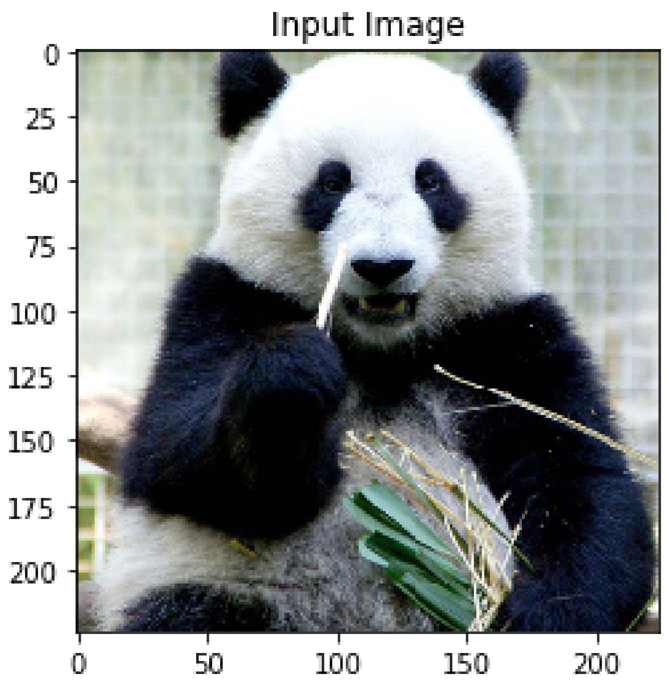


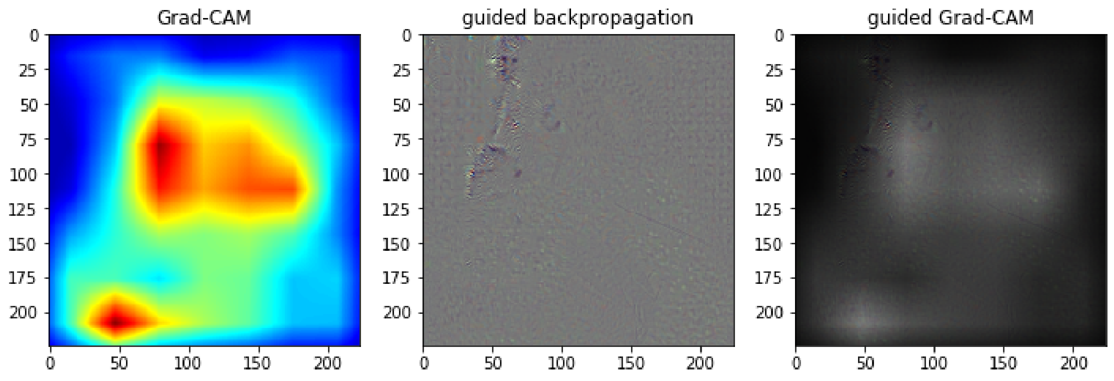
```
Top1:  n01616318 vulture 0.22558181
Top5:  [('n01616318 vulture', 0.22558181), ('n01582220 magpie', 0.1610051), ('n01601694 water 
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



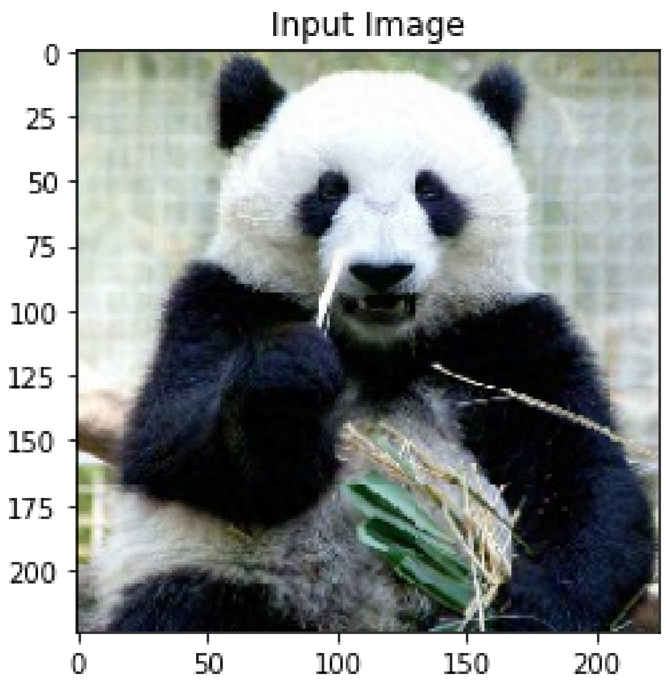


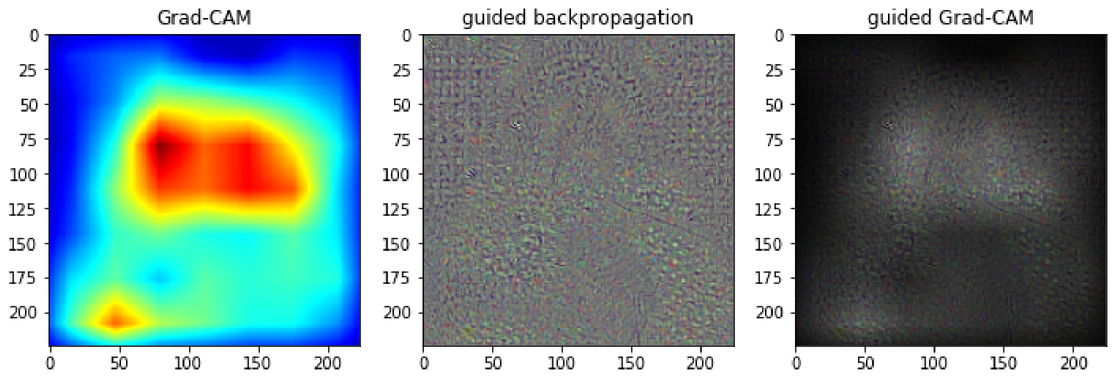
```
Top1:  n02510455 giant panda, panda, panda bear, coon bear, Ailuropoda melanoleuca 0.99680245
Top5:  [('n02510455 giant panda, panda, panda bear, coon bear, Ailuropoda melanoleuca', 0.9968
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



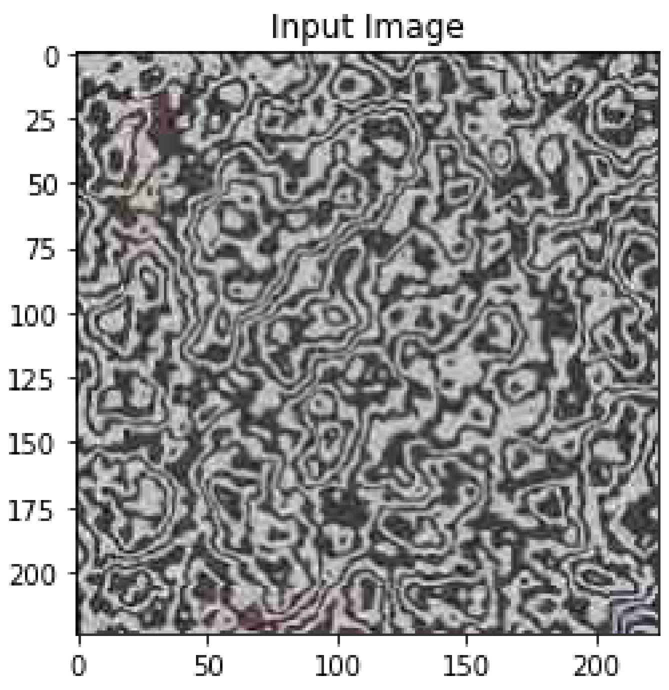


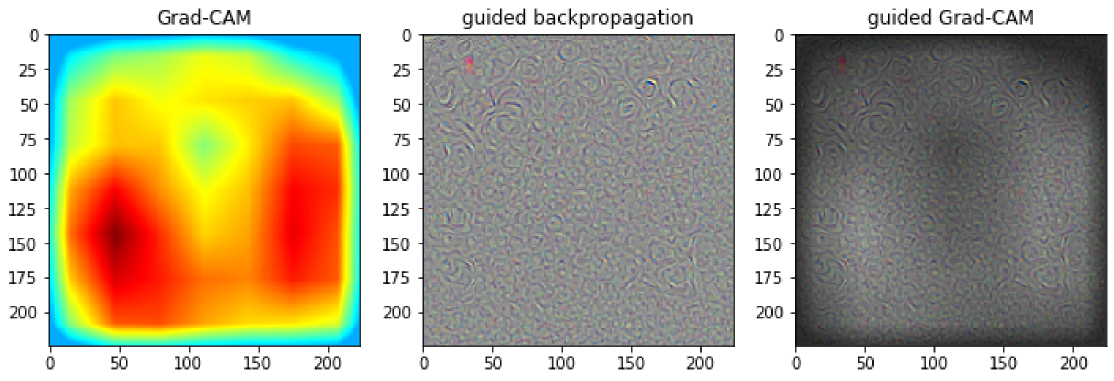
```
Top1:  n02510455 giant panda, panda, panda bear, coon bear, Ailuropoda melanoleuca 0.97880024
Top5:  [('n02510455 giant panda, panda, panda bear, coon bear, Ailuropoda melanoleuca', 0.9788
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```



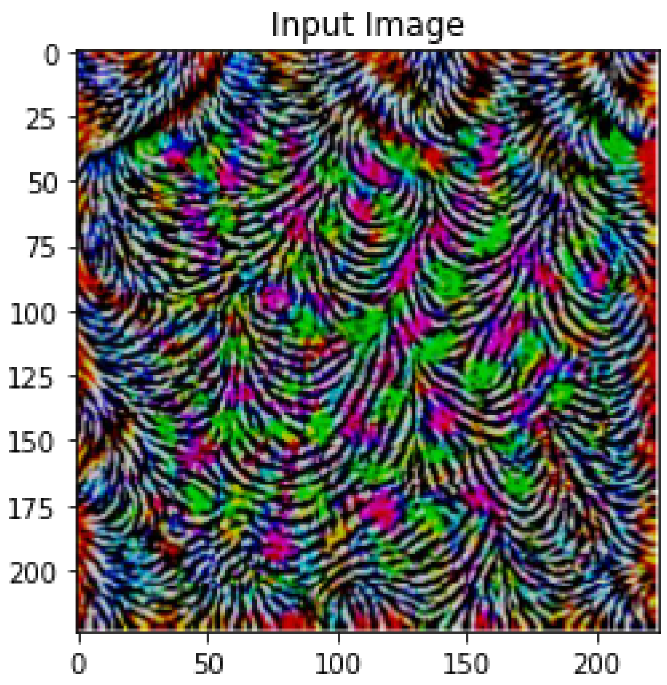


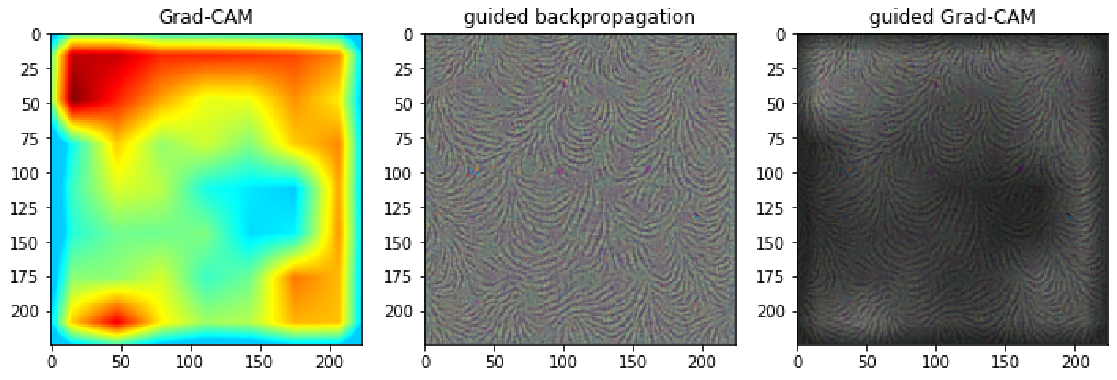
```
Top1:  n02892201 brass, memorial tablet, plaque 0.14574882
Top5:  [('n02892201 brass, memorial tablet, plaque', 0.14574882), ('n03717622 manhole cover', 0
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```





```
Top1:  n03450230 gown 0.33402506
Top5:  [('n03450230 gown', 0.33402506), ('n04136333 sarong', 0.16294378), ('n03045698 cloak', 0
grads_val shape: (7, 7, 2048)
gb_viz shape: (224, 224, 3)
```


Input Image
0
25
50
75
100
125
150
175
200
0
50
100
150
200


Grad-CAM
guided backpropagation
guided Grad-CAM
0
25
50
75
100
125
150
175
200
0
50
100
150
200