DAI_ASSIGNMENT_3_Q1.ipynb

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Question 1 (Visualisation): [30 Marks]

Dataset: CIFAR-10
Aim: Implementation of GradCam.
Model: Select a deep learning model (ex. Resnet18, VGG16 etc.) and train it for 10-class classification.
(**Note**: You may use your trained model for CIFAR10 dataset from Assignment 1, Question 3)

a. Report the accuracy obtained on the test set.
b. Select 10 samples from each class which were correctly classified by the trained model. Apply GradCam on it and visualise most salient regions being used for prediction.
c. Select 5 samples from each class which were incorrectly classified by the trained model and apply GradCam to visualise most salient regions along with the predicted class and confidence.

Reference Article:
https://towardsdatascience.com/demystifying-convolutional-neural-networks-using-gradcam-554a85dd4e48
Reference Paper: https://arxiv.org/pdf/1610.02391.pdf

Links -

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Reference Paper: https://arxiv.org/pdf/1610.02391.pdf

```
[2] from keras.datasets import cifar10
    from keras.utils import to_categorical
    from keras.models import Sequential
    from keras.layers import Conv2D
    from keras.layers import MaxPooling2D
    from keras.layers import Dense
    from keras.layers import Flatten
    from keras.optimizers import SGD
    from tensorflow.keras import datasets
    import numpy as np
    import matplotlib.pyplot as plt
    import tensorflow as tf
    from tensorflow.keras import layers, models
```

```
[3]
    filtered_images=[]
    (train_images, train_labels), (test_images, test_labels)= datasets.cifar10.load_data()
    print('Images Shape: {}'.format(train_images.shape))
    print('Labels Shape: {}'.format(train_labels.shape))
    for i in range(0,10):
      idx = (train_labels == i).reshape(train_images.shape[0])
      # print('Index Shape: {}'.format(idx.shape))
      filtered_images.append(train_images[idx])
    print('Filtered Images Shape: {}'.format(np.array(filtered_images).shape))

    # Train Images
    Xtrain_airplane = np.array(filtered_images[0])
    Xtrain_automobile = np.array(filtered_images[1])
    Xtrain_bird = np.array(filtered_images[2])
    Xtrain_cat = np.array(filtered_images[3])
    Xtrain_deer = np.array(filtered_images[4])
    Xtrain_dog = np.array(filtered_images[5])
    Xtrain_frog = np.array(filtered_images[6])
    Xtrain_horse = np.array(filtered_images[7])
    Xtrain_ship = np.array(filtered_images[8])
    Xtrain_truck = np.array(filtered_images[9])
```

```
Downloading data from https://www.cs.toronto.edu/~kriz/cifar-10-python.tar.gz
170500096/170498071 [==============================] - 6s 0us/step
Images Shape: (50000, 32, 32, 3)
Labels Shape: (50000, 1)
Filtered Images Shape: (10, 5000, 32, 32, 3)
```

```
[4] filtered_labels = []
    for i in range(0,10):
      idx = (train_labels == i).reshape(train_labels.shape[0])
      filtered_labels.append(train_labels[idx])
    print('Filtered labels Shape: {}'.format(np.array(filtered_labels).shape))
    # Train Labels
    Ytrain_airplane = filtered_labels[0]
    Ytrain_automobile = filtered_labels[1]
    Ytrain_bird = filtered_labels[2]
    Ytrain_cat = filtered_labels[3]
    Ytrain_deer = filtered_labels[4]
    Ytrain_dog = filtered_labels[5]
    Ytrain_frog = filtered_labels[6]
    Ytrain_horse = filtered_labels[7]
    Ytrain_ship = filtered_labels[8]
    Ytrain_truck = filtered_labels[9]
```

```
Filtered labels Shape: (10, 5000, 1)
```

```
[5] filtered_images_test = []
    for i in range(0,10):
      idx = (test_labels == i).reshape(test_images.shape[0])
      # print('Index Shape: {}'.format(idx.shape))
      filtered_images_test.append(test_images[idx])
    print('Filtered Images Shape: {}'.format(np.array(filtered_images_test).shape))
    # Test Images
    Xtest_airplane = np.array(filtered_images_test[0])
    Xtest_automobile = np.array(filtered_images_test[1])
    Xtest_bird = np.array(filtered_images_test[2])
    Xtest_cat = np.array(filtered_images_test[3])
    Xtest_deer = np.array(filtered_images_test[4])
    Xtest_dog = np.array(filtered_images_test[5])
    Xtest_frog = np.array(filtered_images_test[6])
    Xtest_horse = np.array(filtered_images_test[7])
    Xtest_ship = np.array(filtered_images_test[8])
    Xtest_truck = np.array(filtered_images_test[9])

    filtered_labels_test = []
    for i in range(0,10):
      idx = (test_labels == i).reshape(test_labels.shape[0])
      filtered_labels_test.append(test_labels[idx])
    print('Filtered labels Shape: {}'.format(np.array(filtered_labels_test).shape))

    # Test Labels
    Ytest_airplane = filtered_labels_test[0]
    Ytest_automobile = filtered_labels_test[1]
    Ytest_bird = filtered_labels_test[2]
    Ytest_cat = filtered_labels_test[3]
    Ytest_deer = filtered_labels_test[4]
    Ytest_dog = filtered_labels_test[5]
    Ytest_frog = filtered_labels_test[6]
    Ytest_horse = filtered_labels_test[7]
    Ytest_ship = filtered_labels_test[8]
    Ytest_truck = filtered_labels_test[9]
```

```
Filtered Images Shape: (10, 1000, 32, 32, 3)
Filtered labels Shape: (10, 1000, 1)
```

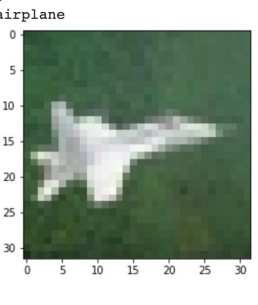
```
[6] X_train = np.concatenate((Xtrain_airplane,
                              Xtrain_automobile,
                              Xtrain_bird,
                              Xtrain_cat,
                              Xtrain_deer,
                              Xtrain_dog,
                              Xtrain_frog,
                              Xtrain_horse,
                              Xtrain_ship,
                              Xtrain_truck))

    Y_train = np.concatenate((Ytrain_airplane,
                              Ytrain_automobile,
                              Ytrain_bird,
                              Ytrain_cat,
                              Ytrain_deer,
                              Ytrain_dog,
                              Ytrain_frog,
                              Ytrain_horse,
                              Ytrain_ship,
                              Ytrain_truck))

    X_test = np.concatenate((Xtest_airplane,
                             Xtest_automobile,
                             Xtest_bird,
                             Xtest_cat,
                             Xtest_deer,
                             Xtest_dog,
                             Xtest_frog,
                             Xtest_horse,
                             Xtest_ship,
                             Xtest_truck))

    Y_test = np.concatenate((Ytest_airplane,
                             Ytest_automobile,
                             Ytest_bird,
                             Ytest_cat,
                             Ytest_deer,
                             Ytest_dog,
                             Ytest_frog,
                             Ytest_horse,
                             Ytest_ship,
                             Ytest_truck))
    print(X_train.shape)
    print(Y_train.shape)
    print(X_test.shape)
    print(Y_test.shape)
```

```
(50000, 32, 32, 3)
(50000, 1)
(10000, 32, 32, 3)
(10000, 1)
```

```
[7] classes = ["airplane",#0
               "automobile",#1
               "bird",#2
               "cat",#3
               "deer",#4
               "dog",#5
               "frog",#6
               "horse",#7
               "ship",#8
               "truck"#9
               ]
```

```
[8]
    def show_label_and_image(X,Y,index):
      print("The image in training set is desiplayed as:")
      plt.imshow(np.array(X[index]))
      print("The label associated with this image is in training set:")
      print(Y[index][0])
      print(classes[Y[index][0]])
    show_label_and_image(X_train, Y_train, 4)
```

```
The image in training set is desiplayed as:
The label associated with this image is in training set:
0
airplane
```



PART A

```
[9] # define cnn model
    model = Sequential()
    model.add(Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 3)))
    model.add(Conv2D(32, (3, 3), activation='relu'))
    model.add(MaxPooling2D((2, 2)))
    model.add(Conv2D(64, (3, 3), activation='relu'))
    model.add(Conv2D(64, (3, 3), activation='relu'))
    model.add(MaxPooling2D((2, 2)))
    model.add(Conv2D(128, (3, 3), activation='relu'))
    model.add(Conv2D(128, (3, 3), activation='relu'))
    model.add(Flatten())
    model.add(Dense(128, activation='relu'))
    model.add(Dense(10, activation='softmax'))
    # compile model
    opt = SGD(lr=0.001, momentum=0.9)
    model.compile(optimizer=opt, loss='sparse_categorical_crossentropy', metrics=['accuracy'])

    model.fit(X_train, Y_train, epochs=30)
    model.save('final_model.h5')
```

```
Epoch 1/30
1563/1563 [==============================] - 19s 8ms/step - loss: 2.3820 - accuracy: 0.1845
Epoch 2/30
1563/1563 [==============================] - 12s 8ms/step - loss: 1.6104 - accuracy: 0.4146
Epoch 3/30
1563/1563 [==============================] - 12s 8ms/step - loss: 1.3399 - accuracy: 0.5242
Epoch 4/30
1563/1563 [==============================] - 12s 8ms/step - loss: 1.1970 - accuracy: 0.5777
Epoch 5/30
1563/1563 [==============================] - 12s 8ms/step - loss: 1.0753 - accuracy: 0.6238
Epoch 6/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.9629 - accuracy: 0.6658
Epoch 7/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.8881 - accuracy: 0.6919
Epoch 8/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.8159 - accuracy: 0.7157
Epoch 9/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.7373 - accuracy: 0.7413
Epoch 10/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.7052 - accuracy: 0.7551
Epoch 11/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.6430 - accuracy: 0.7729
Epoch 12/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.5978 - accuracy: 0.7878
Epoch 13/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.5435 - accuracy: 0.8085
Epoch 14/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.5154 - accuracy: 0.8191
Epoch 15/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.4792 - accuracy: 0.8307
Epoch 16/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.4476 - accuracy: 0.8406
Epoch 17/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.4115 - accuracy: 0.8542
Epoch 18/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.3916 - accuracy: 0.8612
Epoch 19/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.3615 - accuracy: 0.8713
Epoch 20/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.3559 - accuracy: 0.8744
Epoch 21/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.3387 - accuracy: 0.8782
Epoch 22/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.3323 - accuracy: 0.8823
Epoch 23/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.3105 - accuracy: 0.8909
Epoch 24/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.2986 - accuracy: 0.8942
Epoch 25/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.2742 - accuracy: 0.9031
Epoch 26/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.2670 - accuracy: 0.9069
Epoch 27/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.2557 - accuracy: 0.9109
Epoch 28/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.2480 - accuracy: 0.9137
Epoch 29/30
1563/1563 [==============================] - 12s 8ms/step - loss: 0.2345 - accuracy: 0.9186
Epoch 30/30
```

```
[10] _, acc = model.evaluate(X_test, Y_test, verbose=0)
     print(acc*100)
```

```
66.430002450943
```

```
[11] X_test[0].shape
     print(np.argmax(model.predict(np.array([X_test[0]]))))
```

```
0
```

```
[12] # Storing Correctly Classified Samples from each class to an array.
     correctly_classified_airplane = []
     correctly_classified_automobile = []
     correctly_classified_bird = []
     correctly_classified_cat = []
     correctly_classified_deer = []
     correctly_classified_dog = []
     correctly_classified_frog = []
     correctly_classified_horse = []
     correctly_classified_ship = []
     correctly_classified_truck = []
```

```
[13] # For Airplane
     count=0
     for i in range(len(Ytest_airplane)):
       if(Ytest_airplane[i] == np.argmax(model.predict(np.array([Xtest_airplane[i]])))):
         count = count+1
         correctly_classified_airplane.append(np.array([Xtest_airplane[i]]))
         if(count==10):
           break
     print(len(correctly_classified_airplane))
     print(np.array(correctly_classified_airplane).shape)
     print(np.array(correctly_classified_airplane).reshape((10,32,32,3)).shape)
     correctly_classified_airplane = np.array(correctly_classified_airplane).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[14] # For automobile
     count=0
     for i in range(len(Ytest_automobile)):
       if(Ytest_automobile[i] == np.argmax(model.predict(np.array([Xtest_automobile[i]])))):
         count = count+1
         correctly_classified_automobile.append(np.array([Xtest_automobile[i]]))
         if(count==10):
           break
     print(len(correctly_classified_automobile))
     print(np.array(correctly_classified_automobile).shape)
     print(np.array(correctly_classified_automobile).reshape((10,32,32,3)).shape)
     correctly_classified_automobile = np.array(correctly_classified_automobile).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[15] # For bird
     count=0
     for i in range(len(Ytest_bird)):
       if(Ytest_bird[i] == np.argmax(model.predict(np.array([Xtest_bird[i]])))):
         count = count+1
         correctly_classified_bird.append(np.array([Xtest_bird[i]]))
         if(count==10):
           break
     print(len(correctly_classified_bird))
     print(np.array(correctly_classified_bird).shape)
     print(np.array(correctly_classified_bird).reshape((10,32,32,3)).shape)
     correctly_classified_bird = np.array(correctly_classified_bird).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[16] # For cat
     count=0
     for i in range(len(Ytest_cat)):
       if(Ytest_cat[i] == np.argmax(model.predict(np.array([Xtest_cat[i]])))):
         count = count+1
         correctly_classified_cat.append(np.array([Xtest_cat[i]]))
         if(count==10):
           break
     print(len(correctly_classified_cat))
     print(np.array(correctly_classified_cat).shape)
     print(np.array(correctly_classified_cat).reshape((10,32,32,3)).shape)
     correctly_classified_cat = np.array(correctly_classified_cat).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[17] # For deer
     count=0
     for i in range(len(Ytest_deer)):
       if(Ytest_deer[i] == np.argmax(model.predict(np.array([Xtest_deer[i]])))):
         count = count+1
         correctly_classified_deer.append(np.array([Xtest_deer[i]]))
         if(count==10):
           break
     print(len(correctly_classified_deer))
     print(np.array(correctly_classified_deer).shape)
     print(np.array(correctly_classified_deer).reshape((10,32,32,3)).shape)
     correctly_classified_deer = np.array(correctly_classified_deer).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[18] # For dog
     count=0
     for i in range(len(Ytest_dog)):
       if(Ytest_dog[i] == np.argmax(model.predict(np.array([Xtest_dog[i]])))):
         count = count+1
         correctly_classified_dog.append(np.array([Xtest_dog[i]]))
         if(count==10):
           break
     print(len(correctly_classified_dog))
     print(np.array(correctly_classified_dog).shape)
     print(np.array(correctly_classified_dog).reshape((10,32,32,3)).shape)
     correctly_classified_dog = np.array(correctly_classified_dog).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[19] # For frog
     count=0
     for i in range(len(Ytest_frog)):
       if(Ytest_frog[i] == np.argmax(model.predict(np.array([Xtest_frog[i]])))):
         count = count+1
         correctly_classified_frog.append(np.array([Xtest_frog[i]]))
         if(count==10):
           break
     print(len(correctly_classified_frog))
     print(np.array(correctly_classified_frog).shape)
     print(np.array(correctly_classified_frog).reshape((10,32,32,3)).shape)
     correctly_classified_frog = np.array(correctly_classified_frog).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[20] # For horse
     count=0
     for i in range(len(Ytest_horse)):
       if(Ytest_horse[i] == np.argmax(model.predict(np.array([Xtest_horse[i]])))):
         count = count+1
         correctly_classified_horse.append(np.array([Xtest_horse[i]]))
         if(count==10):
           break
     print(len(correctly_classified_horse))
     print(np.array(correctly_classified_horse).shape)
     print(np.array(correctly_classified_horse).reshape((10,32,32,3)).shape)
     correctly_classified_horse = np.array(correctly_classified_horse).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[21] # For ship
     count=0
     for i in range(len(Ytest_ship)):
       if(Ytest_ship[i] == np.argmax(model.predict(np.array([Xtest_ship[i]])))):
         count = count+1
         correctly_classified_ship.append(np.array([Xtest_ship[i]]))
         if(count==10):
           break
     print(len(correctly_classified_ship))
     print(np.array(correctly_classified_ship).shape)
     print(np.array(correctly_classified_ship).reshape((10,32,32,3)).shape)
     correctly_classified_ship = np.array(correctly_classified_ship).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

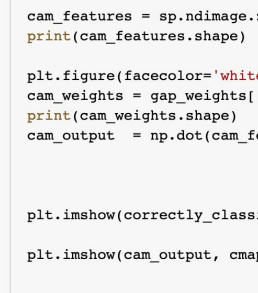
```
[22] # For truck
     count=0
     for i in range(len(Ytest_truck)):
       if(Ytest_truck[i] == np.argmax(model.predict(np.array([Xtest_truck[i]])))):
         count = count+1
         correctly_classified_truck.append(np.array([Xtest_truck[i]]))
         if(count==10):
           break
     print(len(correctly_classified_truck))
     print(np.array(correctly_classified_truck).shape)
     print(np.array(correctly_classified_truck).reshape((10,32,32,3)).shape)
     correctly_classified_truck = np.array(correctly_classified_truck).reshape((10,32,32,3))
```

```
10
(10, 1, 32, 32, 3)
(10, 32, 32, 3)
```

```
[23] # Printing shapes for each correct classes what we have got so far!
     # Storing Correctly Classified Samples from each class to an array.
     print(correctly_classified_airplane.shape)
     print(correctly_classified_automobile.shape)
     print(correctly_classified_bird.shape)
     print(correctly_classified_cat.shape)
     print(correctly_classified_deer.shape)
     print(correctly_classified_dog.shape)
     print(correctly_classified_frog.shape)
     print(correctly_classified_horse.shape)
     print(correctly_classified_ship.shape)
     print(correctly_classified_truck.shape)
```

```
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
(10, 32, 32, 3)
```

```
[24] for eachimg in correctly_classified_airplane:
       plt.imshow(eachimg)
       break
```



```
[25] from keras.models import Model
     import scipy as sp
     gap_weights = model.layers[-1].get_weights()[0]
     gap_weights.shape
```

```
(128, 10)
```

```
[26] cam_model  = Model(inputs=model.input,outputs=(model.layers[-5].output,model.layers[-1].output))
```

```
[27] cam_model.summary()
```

```
Model: "model"
_________________________________________________________________
Layer (type)                Output Shape              Param #
=================================================================
conv2d_input (InputLayer)   [(None, 32, 32, 3)]       0

conv2d (Conv2D)             (None, 30, 30, 32)        896

conv2d_1 (Conv2D)           (None, 28, 28, 32)        9248

max_pooling2d (MaxPooling2D) (None, 14, 14, 32)       0

conv2d_2 (Conv2D)           (None, 12, 12, 64)        18496

conv2d_3 (Conv2D)           (None, 10, 10, 64)        36928

max_pooling2d_1 (MaxPooling2 (None, 5, 5, 64)         0

conv2d_4 (Conv2D)           (None, 3, 3, 128)         73856

conv2d_5 (Conv2D)           (None, 1, 1, 128)         147584

flatten (Flatten)           (None, 128)               0

dense (Dense)               (None, 128)               16512

dense_1 (Dense)             (None, 10)                1290
=================================================================
Total params: 304,810
Trainable params: 304,810
Non-trainable params: 0
_________________________________________________________________
```

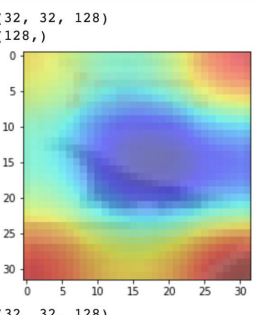
PART B

```
[ ] # for visualizations ref: https://github.com/Divyanshupy/CLASS-ACTIVATION-MAPS/blob/master/Class%20Activation%20Maps%20with%20MaxPooling.ipynb
```

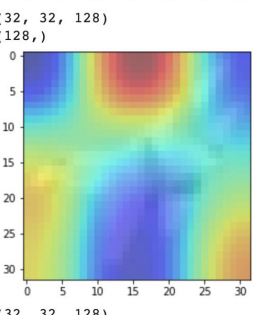
For Airplane

```
[28] # For Airplane
     features,results = cam_model.predict(correctly_classified_airplane)
     features.shape
     for idx in range(10):
         correctly_classified_airplane[idx] = np.expand_dims(correctly_classified_airplane[idx],axis=0)
         features_for_one_img = features[idx,:,:,:]
         height_roomout = correctly_classified_airplane.shape[1]/features_for_one_img.shape[0]
         width_roomout  = correctly_classified_airplane.shape[2]/features_for_one_img.shape[1]

         cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
         print(cam_features.shape)

         plt.figure(facecolor='white')
         cam_weights = gap_weights[:,0]
         print(cam_weights.shape)
         cam_output  = np.dot(cam_features,cam_weights)



         plt.imshow(correctly_classified_airplane[idx], alpha=0.5)

         plt.imshow(cam_output, cmap='jet', alpha=0.5)



         plt.show()
```

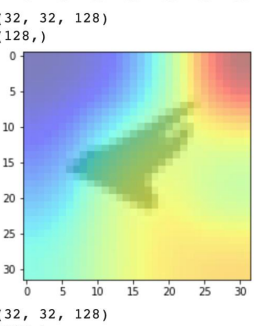
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

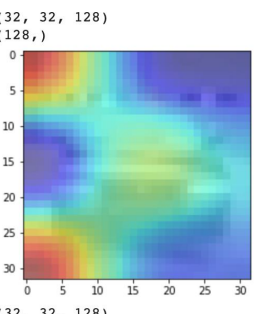
```
[ ]
```

For Automobile

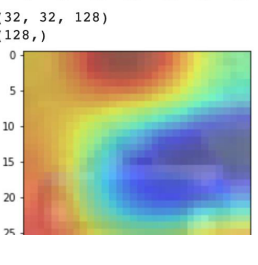
```
[ ]
```

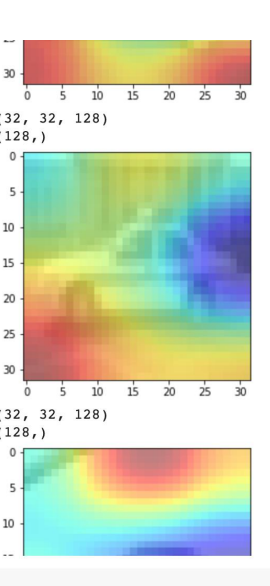
```
[29] # For automobile
     features,results = cam_model.predict(correctly_classified_automobile)
     features.shape
     for idx in range(10):
         correctly_classified_automobile[idx] = np.expand_dims(correctly_classified_automobile[idx],axis=0)
         features_for_one_img = features[idx,:,:,:]
         height_roomout = correctly_classified_automobile.shape[1]/features_for_one_img.shape[0]
         width_roomout  = correctly_classified_automobile.shape[2]/features_for_one_img.shape[1]

         cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
         print(cam_features.shape)

         plt.figure(facecolor='white')
         cam_weights = gap_weights[:,1]
         print(cam_weights.shape)
         cam_output  = np.dot(cam_features,cam_weights)



         plt.imshow(correctly_classified_automobile[idx], alpha=0.5)

         plt.imshow(cam_output, cmap='jet', alpha=0.5)



         plt.show()
```

```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



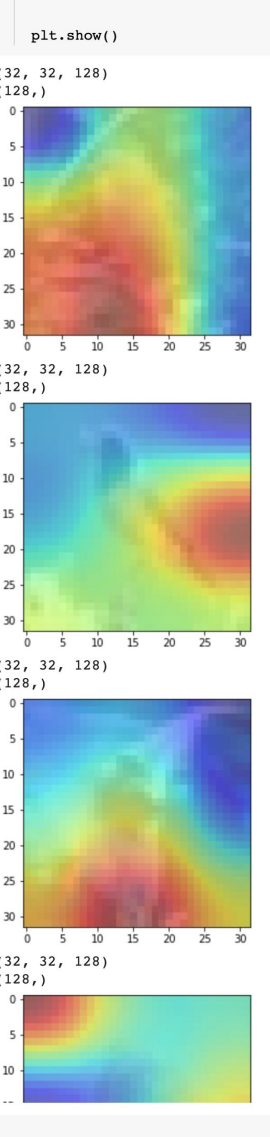


[ ]

For Bird

```
[31] # For bird
features,results = cam_model.predict(correctly_classified_bird)
features.shape
for idx in range(10):
    correctly_classified_bird[idx] = np.expand_dims(correctly_classified_bird[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_bird.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_bird.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,2]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_bird[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

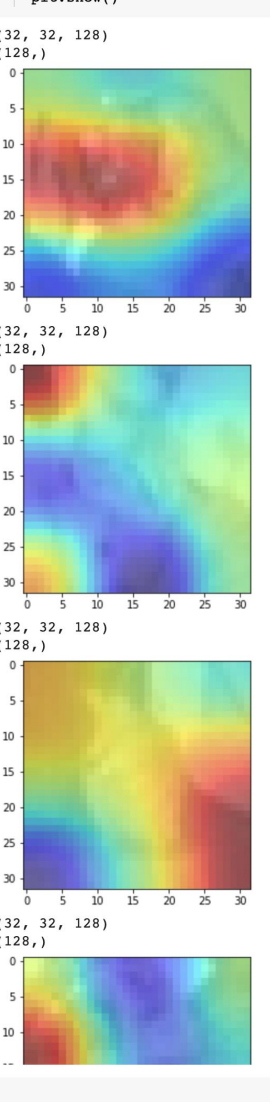


[ ]

For Cat

```
[32] # For cat
features,results = cam_model.predict(correctly_classified_cat)
features.shape
for idx in range(10):
    correctly_classified_cat[idx] = np.expand_dims(correctly_classified_cat[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_cat.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_cat.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,3]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_cat[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

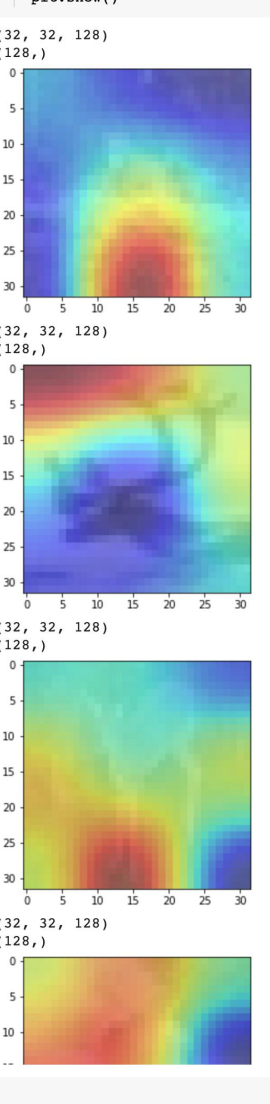


[ ]

For Deer

```
[33] # For deer
features,results = cam_model.predict(correctly_classified_deer)
features.shape
for idx in range(10):
    correctly_classified_deer[idx] = np.expand_dims(correctly_classified_deer[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_deer.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_deer.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,4]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_deer[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

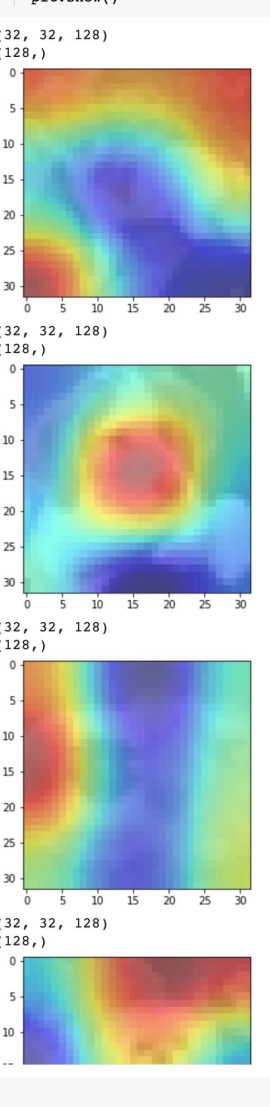


[ ]

For Dog

```
[34] # For dog
features,results = cam_model.predict(correctly_classified_dog)
features.shape
for idx in range(10):
    correctly_classified_dog[idx] = np.expand_dims(correctly_classified_dog[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_dog.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_dog.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,5]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_dog[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

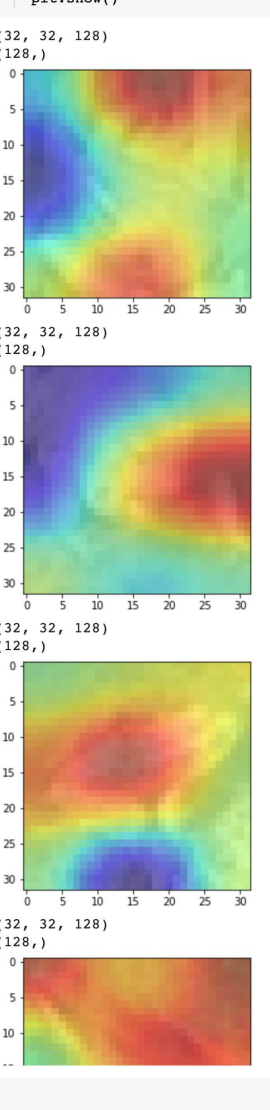


[ ]

For Frog

```
[35] # For frog
features,results = cam_model.predict(correctly_classified_frog)
features.shape
for idx in range(10):
    correctly_classified_frog[idx] = np.expand_dims(correctly_classified_frog[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_frog.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_frog.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,6]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_frog[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

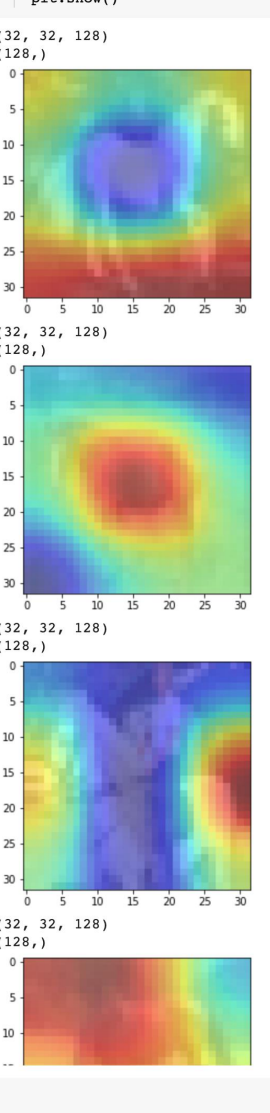


[ ]

For Horse

```
[36] # For horse
features,results = cam_model.predict(correctly_classified_horse)
features.shape
for idx in range(10):
    correctly_classified_horse[idx] = np.expand_dims(correctly_classified_horse[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_horse.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_horse.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,7]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_horse[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

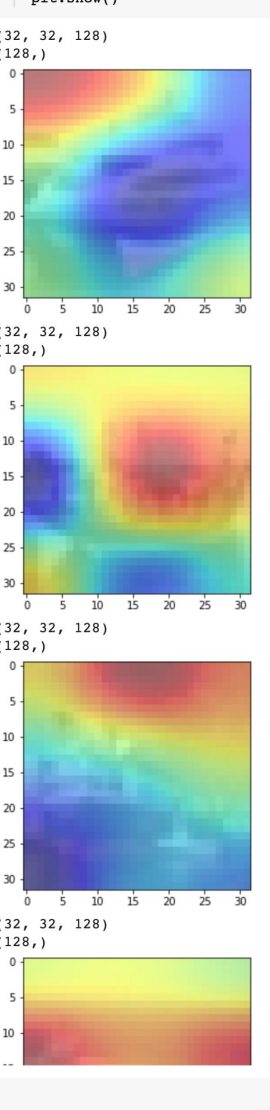


[ ]

For Ship

```
[37] # For ship
features,results = cam_model.predict(correctly_classified_ship)
features.shape
for idx in range(10):
    correctly_classified_ship[idx] = np.expand_dims(correctly_classified_ship[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_ship.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_ship.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,8]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_ship[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

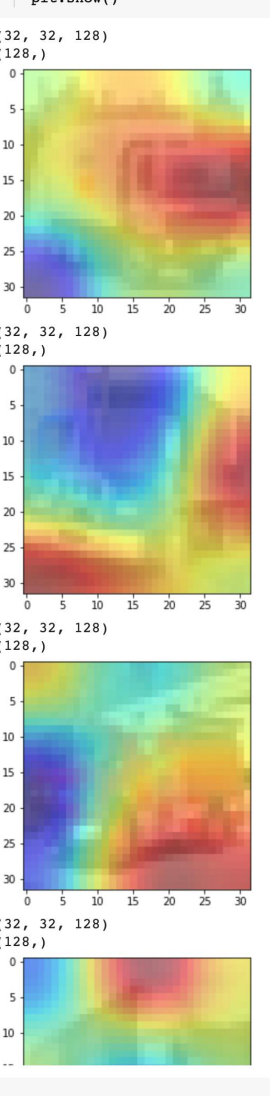


[ ]

For Truck

```
[38] # For truck
features,results = cam_model.predict(correctly_classified_truck)
features.shape
for idx in range(10):
    correctly_classified_truck[idx] = np.expand_dims(correctly_classified_truck[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = correctly_classified_truck.shape[1]/features_for_one_img.shape[0]
    width_roomout  = correctly_classified_truck.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,9]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(correctly_classified_truck[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```



[ ]

PART C

[ ]

```
[39] # Storing incorrectly Classified Samples from each class to an array.
incorrectly_classified_airplane = []
incorrectly_classified_automobile = []
incorrectly_classified_bird = []
incorrectly_classified_cat = []
incorrectly_classified_deer = []
incorrectly_classified_dog = []
incorrectly_classified_frog = []
incorrectly_classified_horse = []
incorrectly_classified_ship = []
incorrectly_classified_truck = []
```

```
[40] # For Airplane
count=0
for i in range(len(Ytest_airplane)):
  if(Ytest_airplane[i] != np.argmax(model.predict(np.array([Xtest_airplane[i]])))):
    count = count+1
    incorrectly_classified_airplane.append(np.array([Xtest_airplane[i]]))
    if(count==5):
      break
```

```
print(len(incorrectly_classified_airplane))
print(np.array(incorrectly_classified_airplane).shape)
print(np.array(incorrectly_classified_airplane).reshape((5,32,32,3)).shape)
incorrectly_classified_airplane = np.array(incorrectly_classified_airplane).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[41] # For automobile
count=0
for i in range(len(Ytest_automobile)):
  if(Ytest_automobile[i] != np.argmax(model.predict(np.array([Xtest_automobile[i]])))):
    count = count+1
    incorrectly_classified_automobile.append(np.array([Xtest_automobile[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_automobile))
print(np.array(incorrectly_classified_automobile).shape)
print(np.array(incorrectly_classified_automobile).reshape((5,32,32,3)).shape)
incorrectly_classified_automobile = np.array(incorrectly_classified_automobile).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[42] # For bird
count=0
for i in range(len(Ytest_bird)):
  if(Ytest_bird[i] != np.argmax(model.predict(np.array([Xtest_bird[i]])))):
    count = count+1
    incorrectly_classified_bird.append(np.array([Xtest_bird[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_bird))
print(np.array(incorrectly_classified_bird).shape)
print(np.array(incorrectly_classified_bird).reshape((5,32,32,3)).shape)
incorrectly_classified_bird = np.array(incorrectly_classified_bird).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[43] # For cat
count=0
for i in range(len(Ytest_cat)):
  if(Ytest_cat[i] != np.argmax(model.predict(np.array([Xtest_cat[i]])))):
    count = count+1
    incorrectly_classified_cat.append(np.array([Xtest_cat[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_cat))
print(np.array(incorrectly_classified_cat).shape)
print(np.array(incorrectly_classified_cat).reshape((5,32,32,3)).shape)
incorrectly_classified_cat = np.array(incorrectly_classified_cat).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[44] # For deer
count=0
for i in range(len(Ytest_deer)):
  if(Ytest_deer[i] != np.argmax(model.predict(np.array([Xtest_deer[i]])))):
    count = count+1
    incorrectly_classified_deer.append(np.array([Xtest_deer[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_deer))
print(np.array(incorrectly_classified_deer).shape)
print(np.array(incorrectly_classified_deer).reshape((5,32,32,3)).shape)
incorrectly_classified_deer = np.array(incorrectly_classified_deer).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[45] # For dog
count=0
for i in range(len(Ytest_dog)):
  if(Ytest_dog[i] != np.argmax(model.predict(np.array([Xtest_dog[i]])))):
    count = count+1
    incorrectly_classified_dog.append(np.array([Xtest_dog[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_dog))
print(np.array(incorrectly_classified_dog).shape)
print(np.array(incorrectly_classified_dog).reshape((5,32,32,3)).shape)
incorrectly_classified_dog = np.array(incorrectly_classified_dog).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[46] # For frog
count=0
for i in range(len(Ytest_frog)):
  if(Ytest_frog[i] != np.argmax(model.predict(np.array([Xtest_frog[i]])))):
    count = count+1
    incorrectly_classified_frog.append(np.array([Xtest_frog[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_frog))
print(np.array(incorrectly_classified_frog).shape)
print(np.array(incorrectly_classified_frog).reshape((5,32,32,3)).shape)
incorrectly_classified_frog = np.array(incorrectly_classified_frog).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[47] # For horse
count=0
for i in range(len(Ytest_horse)):
  if(Ytest_horse[i] != np.argmax(model.predict(np.array([Xtest_horse[i]])))):
    count = count+1
    incorrectly_classified_horse.append(np.array([Xtest_horse[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_horse))
print(np.array(incorrectly_classified_horse).shape)
print(np.array(incorrectly_classified_horse).reshape((5,32,32,3)).shape)
incorrectly_classified_horse = np.array(incorrectly_classified_horse).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[48] # For ship
count=0
for i in range(len(Ytest_ship)):
  if(Ytest_ship[i] != np.argmax(model.predict(np.array([Xtest_ship[i]])))):
    count = count+1
    incorrectly_classified_ship.append(np.array([Xtest_ship[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_ship))
print(np.array(incorrectly_classified_ship).shape)
print(np.array(incorrectly_classified_ship).reshape((5,32,32,3)).shape)
incorrectly_classified_ship = np.array(incorrectly_classified_ship).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[49] # For truck
count=0
for i in range(len(Ytest_truck)):
  if(Ytest_truck[i] != np.argmax(model.predict(np.array([Xtest_truck[i]])))):
    count = count+1
    incorrectly_classified_truck.append(np.array([Xtest_truck[i]]))
    if(count==5):
      break
print(len(incorrectly_classified_truck))
print(np.array(incorrectly_classified_truck).shape)
print(np.array(incorrectly_classified_truck).reshape((5,32,32,3)).shape)
incorrectly_classified_truck = np.array(incorrectly_classified_truck).reshape((5,32,32,3))
```

```
5
(5, 1, 32, 32, 3)
(5, 32, 32, 3)
```

```
[51] # Printing shapes for each correct classes what we have got so far!
# Storing inCorrectly Classified Samples from each class to an array.
print(incorrectly_classified_airplane.shape)
print(incorrectly_classified_automobile.shape)
print(incorrectly_classified_bird.shape)
print(incorrectly_classified_cat.shape)
print(incorrectly_classified_deer.shape)
print(incorrectly_classified_dog.shape)
print(incorrectly_classified_frog.shape)
print(incorrectly_classified_horse.shape)
print(incorrectly_classified_ship.shape)
print(incorrectly_classified_truck.shape)
```

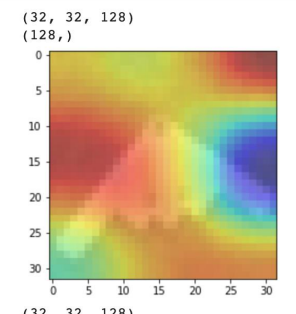
```
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
(5, 32, 32, 3)
```

```
[ ]
```

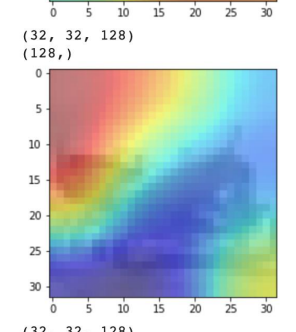
For Airplane

```
[52] # For Airplane
features,results = cam_model.predict(incorrectly_classified_airplane)
features.shape
for idx in range(5):
    incorrectly_classified_airplane[idx] = np.expand_dims(incorrectly_classified_airplane[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_airplane.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_airplane.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,0]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_airplane[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

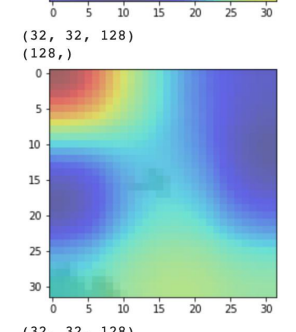
```
(32, 32, 128)
(128,)
```



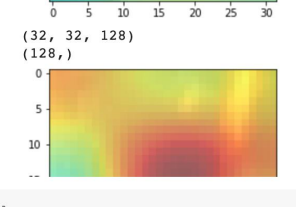
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



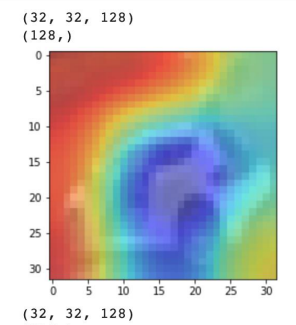
```
[ ]
```

For Automobile

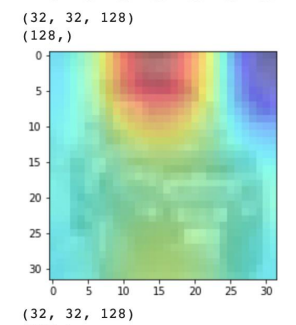
```
[ ]
```

```
[53] # For automobile
features,results = cam_model.predict(incorrectly_classified_automobile)
features.shape
for idx in range(5):
    incorrectly_classified_automobile[idx] = np.expand_dims(incorrectly_classified_automobile[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_automobile.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_automobile.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,1]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_automobile[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

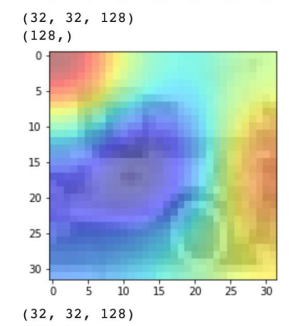
```
(32, 32, 128)
(128,)
```



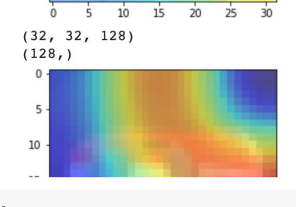
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

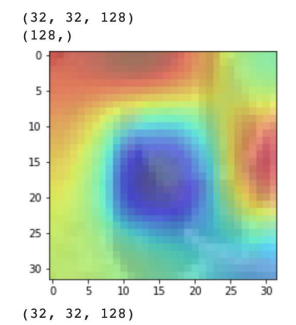


```
[ ]
```

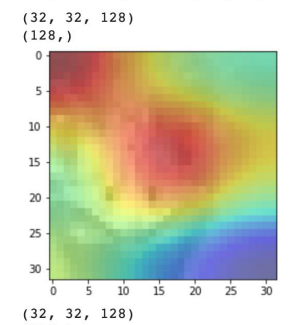
For Bird

```
[54] # For bird
features,results = cam_model.predict(incorrectly_classified_bird)
features.shape
for idx in range(5):
    incorrectly_classified_bird[idx] = np.expand_dims(incorrectly_classified_bird[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_bird.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_bird.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,2]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_bird[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

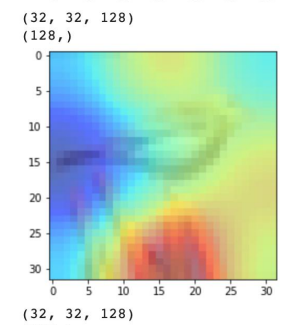
```
(32, 32, 128)
(128,)
```



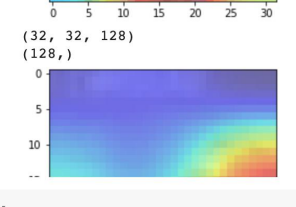
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

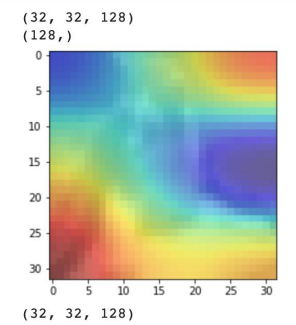


```
[ ]
```

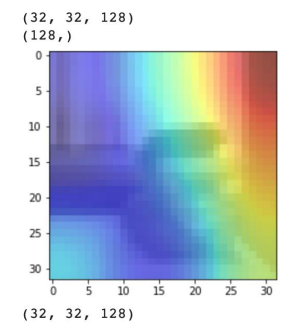
For Cat

```
[55] # For cat
features,results = cam_model.predict(incorrectly_classified_cat)
features.shape
for idx in range(5):
    incorrectly_classified_cat[idx] = np.expand_dims(incorrectly_classified_cat[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_cat.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_cat.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,3]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_cat[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

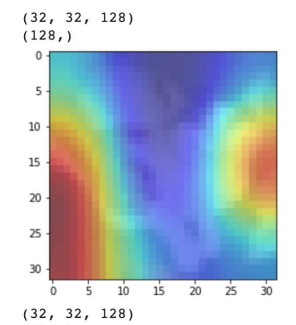
```
(32, 32, 128)
(128,)
```



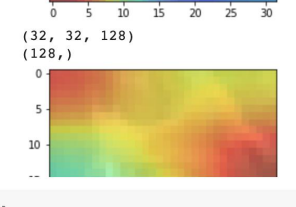
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

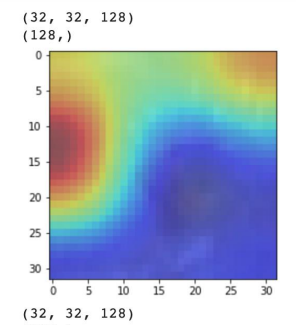


```
[ ]
```

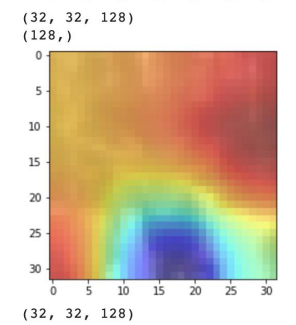
For Deer

```
[56] # For deer
features,results = cam_model.predict(incorrectly_classified_deer)
features.shape
for idx in range(5):
    incorrectly_classified_deer[idx] = np.expand_dims(incorrectly_classified_deer[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_deer.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_deer.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,4]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_deer[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

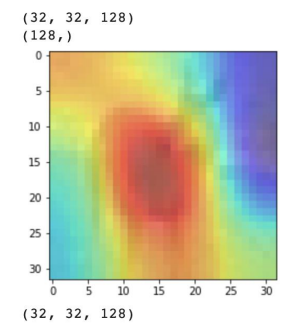
```
(32, 32, 128)
(128,)
```



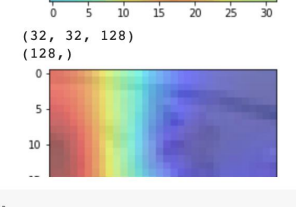
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

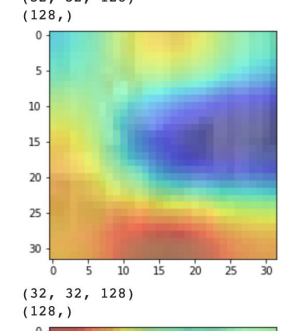


```
[ ]
```

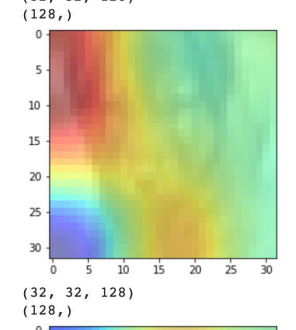
For Dog

```
[57] # For dog
features,results = cam_model.predict(incorrectly_classified_dog)
features.shape
for idx in range(5):
    incorrectly_classified_dog[idx] = np.expand_dims(incorrectly_classified_dog[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_dog.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_dog.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,5]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_dog[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

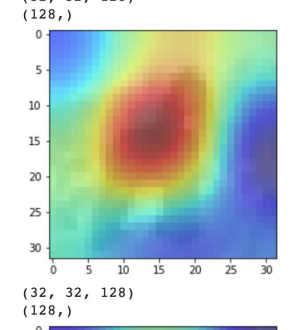
```
(32, 32, 128)
(128,)
```



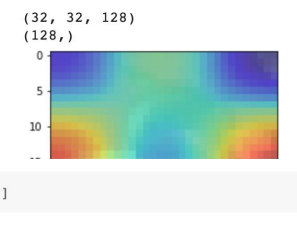
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

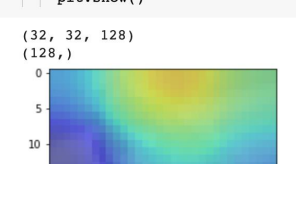


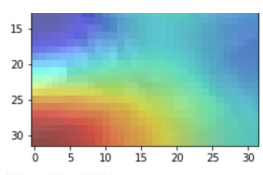
```
[ ]
```

For Frog

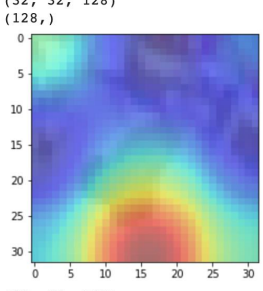
```
[58] # For frog
features,results = cam_model.predict(incorrectly_classified_frog)
features.shape
for idx in range(5):
    incorrectly_classified_frog[idx] = np.expand_dims(incorrectly_classified_frog[idx],axis=0)
    features_for_one_img = features[idx,:,:,:]
    height_roomout = incorrectly_classified_frog.shape[1]/features_for_one_img.shape[0]
    width_roomout  = incorrectly_classified_frog.shape[2]/features_for_one_img.shape[1]

    cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
    print(cam_features.shape)

    plt.figure(facecolor='white')
    cam_weights = gap_weights[:,6]
    print(cam_weights.shape)
    cam_output  = np.dot(cam_features,cam_weights)



    plt.imshow(incorrectly_classified_frog[idx], alpha=0.5)

    plt.imshow(cam_output, cmap='jet', alpha=0.5)



    plt.show()
```

```
(32, 32, 128)
(128,)
```

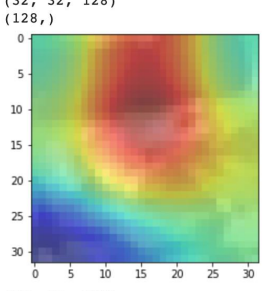




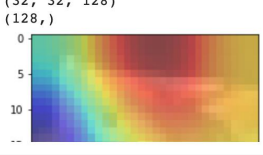
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

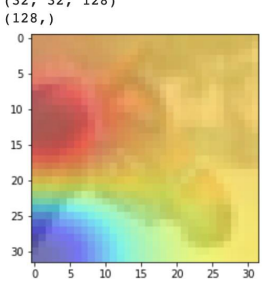


```
[ ]
```

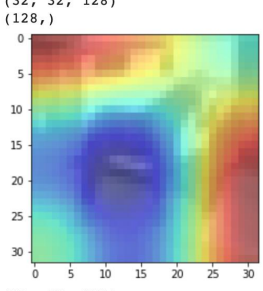
For Horse

```
[59] # For horse
     features,results = cam_model.predict(incorrectly_classified_horse)
     features.shape
     for idx in range(5):
         incorrectly_classified_horse[idx] = np.expand_dims(incorrectly_classified_horse[idx],axis=0)
         features_for_one_img = features[idx,:,:,:]
         height_roomout = incorrectly_classified_horse.shape[1]/features_for_one_img.shape[0]
         width_roomout  = incorrectly_classified_horse.shape[2]/features_for_one_img.shape[1]

         cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
         print(cam_features.shape)

         plt.figure(facecolor='white')
         cam_weights = gap_weights[:,7]
         print(cam_weights.shape)
         cam_output  = np.dot(cam_features,cam_weights)



         plt.imshow(incorrectly_classified_horse[idx], alpha=0.5)

         plt.imshow(cam_output, cmap='jet', alpha=0.5)



         plt.show()
```

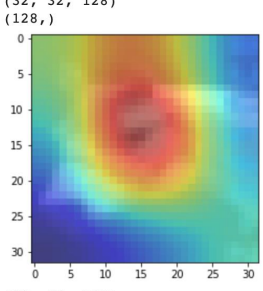
```
(32, 32, 128)
(128,)
```



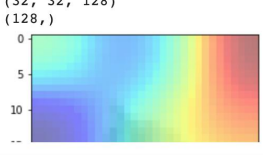
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

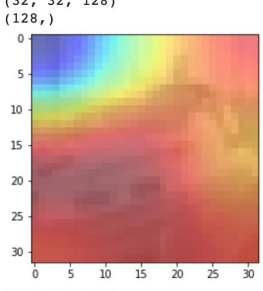


```
[ ]
```

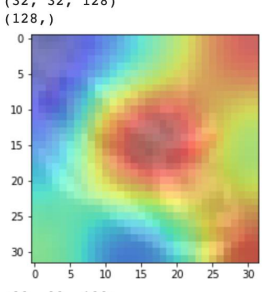
For Ship

```
[60] # For ship
     features,results = cam_model.predict(incorrectly_classified_ship)
     features.shape
     for idx in range(5):
         incorrectly_classified_ship[idx] = np.expand_dims(incorrectly_classified_ship[idx],axis=0)
         features_for_one_img = features[idx,:,:,:]
         height_roomout = incorrectly_classified_ship.shape[1]/features_for_one_img.shape[0]
         width_roomout  = incorrectly_classified_ship.shape[2]/features_for_one_img.shape[1]

         cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
         print(cam_features.shape)

         plt.figure(facecolor='white')
         cam_weights = gap_weights[:,8]
         print(cam_weights.shape)
         cam_output  = np.dot(cam_features,cam_weights)



         plt.imshow(incorrectly_classified_ship[idx], alpha=0.5)

         plt.imshow(cam_output, cmap='jet', alpha=0.5)


         plt.show()
```

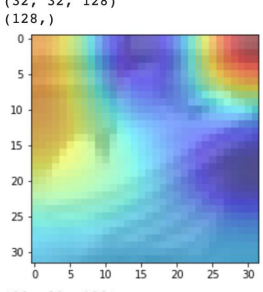
```
(32, 32, 128)
(128,)
```



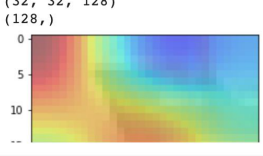
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```

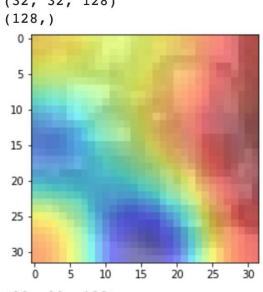


```
[ ]
```

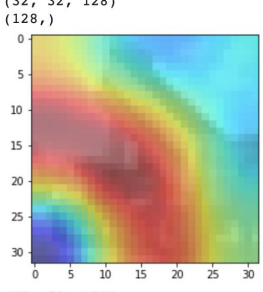
For Truck

```
[61] # For truck
     features,results = cam_model.predict(incorrectly_classified_truck)
     features.shape
     for idx in range(5):
         incorrectly_classified_truck[idx] = np.expand_dims(incorrectly_classified_truck[idx],axis=0)
         features_for_one_img = features[idx,:,:,:]
         height_roomout = incorrectly_classified_truck.shape[1]/features_for_one_img.shape[0]
         width_roomout  = incorrectly_classified_truck.shape[2]/features_for_one_img.shape[1]

         cam_features = sp.ndimage.zoom(features_for_one_img, (height_roomout, width_roomout, 1), order=2)
         print(cam_features.shape)

         plt.figure(facecolor='white')
         cam_weights = gap_weights[:,9]
         print(cam_weights.shape)
         cam_output  = np.dot(cam_features,cam_weights)



         plt.imshow(incorrectly_classified_truck[idx], alpha=0.5)

         plt.imshow(cam_output, cmap='jet', alpha=0.5)


         plt.show()
```

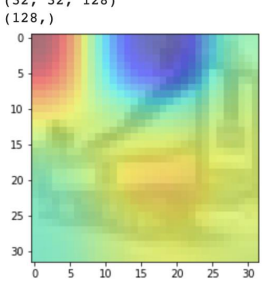
```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```



```
(32, 32, 128)
(128,)
```