**VGG16 was the feature extractor used with top 3 layers removed.**

1. **The dimensions of feature vector were (7, 7, 512) obtained from block\_5 pooling layer of VGG16, which was later flattened for comparison purposes.**
2. **KMeans clustering was used for image prediction.**
3. **The input to the Kmeans algorithm given was such that first few(in our case it was 30) images belong to same class of images(say airplanes), then the other class of images were given sequentially and the mode of the output data from KMeans algorithm was taken for particular interval(in our case, it was 30) and defined to be the class identity for the given class.**
4. **The file path was used for identifying the image contents for comparison of the prediction by algorithm.**

**For instance, images of airplanes were stored in “Images/airplanes\_test/img0xx.jpg”**

**The string “airplanes” present in the file path was used as a justification that the image is of airplane.**

**Following is the output:**

**"D:\Python Projects\venv\Scripts\python.exe" "D:/Python Projects/DIP Assignment 5/Question1.py"**

**2021-11-29 20:44:11.508323: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cudart64\_110.dll'; dlerror: cudart64\_110.dll not found**

**2021-11-29 20:44:11.508588: I tensorflow/stream\_executor/cuda/cudart\_stub.cc:29] Ignore above cudart dlerror if you do not have a GPU set up on your machine.**

**2021-11-29 20:44:15.997245: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cudart64\_110.dll'; dlerror: cudart64\_110.dll not found**

**2021-11-29 20:44:15.997619: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cublas64\_11.dll'; dlerror: cublas64\_11.dll not found**

**2021-11-29 20:44:15.997969: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cublasLt64\_11.dll'; dlerror: cublasLt64\_11.dll not found**

**2021-11-29 20:44:15.998328: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cufft64\_10.dll'; dlerror: cufft64\_10.dll not found**

**2021-11-29 20:44:15.998688: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'curand64\_10.dll'; dlerror: curand64\_10.dll not found**

**2021-11-29 20:44:15.999048: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cusolver64\_11.dll'; dlerror: cusolver64\_11.dll not found**

**2021-11-29 20:44:15.999387: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cusparse64\_11.dll'; dlerror: cusparse64\_11.dll not found**

**2021-11-29 20:44:15.999724: W tensorflow/stream\_executor/platform/default/dso\_loader.cc:64] Could not load dynamic library 'cudnn64\_8.dll'; dlerror: cudnn64\_8.dll not found**

**2021-11-29 20:44:15.999832: W tensorflow/core/common\_runtime/gpu/gpu\_device.cc:1850] Cannot dlopen some GPU libraries. Please make sure the missing libraries mentioned above are installed properly if you would like to use GPU. Follow the guide at https://www.tensorflow.org/install/gpu for how to download and setup the required libraries for your platform.**

**Skipping registering GPU devices...**

**2021-11-29 20:44:16.000317: I tensorflow/core/platform/cpu\_feature\_guard.cc:151] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: AVX AVX2**

**To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.**

**Model: "vgg16"**

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**Layer (type) Output Shape Param #**

**=================================================================**

**input\_1 (InputLayer) [(None, 224, 224, 3)] 0**

**block1\_conv1 (Conv2D) (None, 224, 224, 64) 1792**

**block1\_conv2 (Conv2D) (None, 224, 224, 64) 36928**

**block1\_pool (MaxPooling2D) (None, 112, 112, 64) 0**

**block2\_conv1 (Conv2D) (None, 112, 112, 128) 73856**

**block2\_conv2 (Conv2D) (None, 112, 112, 128) 147584**

**block2\_pool (MaxPooling2D) (None, 56, 56, 128) 0**

**block3\_conv1 (Conv2D) (None, 56, 56, 256) 295168**

**block3\_conv2 (Conv2D) (None, 56, 56, 256) 590080**

**block3\_conv3 (Conv2D) (None, 56, 56, 256) 590080**

**block3\_pool (MaxPooling2D) (None, 28, 28, 256) 0**

**block4\_conv1 (Conv2D) (None, 28, 28, 512) 1180160**

**block4\_conv2 (Conv2D) (None, 28, 28, 512) 2359808**

**block4\_conv3 (Conv2D) (None, 28, 28, 512) 2359808**

**block4\_pool (MaxPooling2D) (None, 14, 14, 512) 0**

**block5\_conv1 (Conv2D) (None, 14, 14, 512) 2359808**

**block5\_conv2 (Conv2D) (None, 14, 14, 512) 2359808**

**block5\_conv3 (Conv2D) (None, 14, 14, 512) 2359808**

**block5\_pool (MaxPooling2D) (None, 7, 7, 512) 0**

**=================================================================**

**Total params: 14,714,688**

**Trainable params: 14,714,688**

**Non-trainable params: 0**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Positive Predictions Made by the Algorithm: 80**

**Negative Predictions Made by the Algorithm: 0**

**Prediction Accuracy is: 100.0 %**

**Time Required to Execute programme: 41.272661447525024 Seconds.**

**Process finished with exit code 0**