

Hello world! What chance is there of this working?

1 Introduction

Computer Vision - is an area of science that studies artificial intelligent, in particular robotics and all technologies that are used to obtain images of real world objects and then apply some actions on them without (full or partial) human presence.

In the assignment given I had to study a small subset of **CIFAR-10** dataset. **CIFAR-10** dataset consists of 60000 32x32 rgb color images, where all of the images are separated in 10 classes. Original dataset has 50000 training images and 10000 test images, and each class has 6000 images. The dataset given to us has 1000 training and 100 testing images. There are a total of 10000 training images and 1000 testing images in the dataset.

After analyzing the dataset I had to make a program that classifies images from the dataset provided. I used several methods in order to achieve the given task. Perform classification using k-nearest neighbour, classification using Support Vector Machine, clustering using k-means classifier and neural network. Reduce data dimensionality using Linear Discriminant Analysis and perform steps above once again on reduced data. To code all of the techniques above I used *scikit-learn* and *keras* libraries.

2 Method

In general the given task can be splitted onto several easier tasks, which are:

1. Feature extraction
2. Data preparation
3. Classification
4. Result analysis

Each of the tasks above steps above can be easily be completed with the use of *scikit-learn* and *keras* libraries.

2.1 Feature extraction

In my opinion operating with raw pixel data in anything but neural network will be a bad idea, since it does not hold any important information for

classifiers like k-means or k-nearest neighbour, but color. Color is not a reliable feature for classification, because same object (for example plane) can be coloured differently on different pictures (for example planes that are being operated by S7 airlines are mostly green, while planes operated by Aeroflot airlines are silver). In order to perform high quality classification I am going to use **Histogram of Oriented Gradients (HOG)** features. In order to compute **HOG**,

1. Make image black and white, since information about colors will be useless.
2. Take a pixel, we need to look at the pixels surrounding it.
3. Determine how dark is our pixel compared to its adjacent pixels
4. Draw an arrow that represents the direction in which pixels become darker.
5. Repeat from step 2 for each pixel in the image.

This method has several key advantages over other descriptors is that it works with local grid and is not sensitive to geometric or photometric properties of the object, appart from its orientation. This is beneficial objects with large area.

2.2 Data preparation

During this step 2 things could possibly be done:

- Perform dimentionality reduction
- Reshape data for neural network.

As a method for dimentionality reduction I decided to choose **Linear Discriminant Analysis(LDA)**, since it provides better between class separation than **Principal Component Analysis(PCA)**.

LDA is a method that is used in statistics, machine learning, object recognition in order to find linear combination of properties. The combination obtained can be used as a linear classifier, or more frequently as a metod of dimentionality reduction before classification.

By reshaping data before feeding it to neural network I mean generating binary class matrix of labels using:

```
keras.utils.to_categorical(y, num_classes=None)
```