CS523 Computer Vision
Report

Image Classification with Bag of Features

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Introduction

This report explains the implementation details of CS523 Computer Vision Assignment 3, which is about classifying a 4-class dataset with bag of features. The general idea behind a bag of visual words is to represent an image as a set of features. Features consist of keypoints and descriptors and no matter if an image is rotated, shrinked or expanded, the keypoints will always be the same. A descriptor is the description of a keypoint. The keypoints and descriptors are used to construct vocabularies and represent each image as a frequency histogram of features that are in the image. By using the frequency histogram, we can find and predict the category of an image.

Running the code

To run the code, you need to re-organize the dataset to look something similar to:

```
dataset
├── train
│   ├── airplanes
│   ├── cars
│   ├── faces
│   └── motorbikes
└── test
    ├── airplanes
    ├── cars
    ├── faces
    └── motorbikes
```

After modifying the directory structure, you should call main.py with the parameters that are needed to run the experiment you want. For example, the following snippet will set the feature extraction method to keypoints, will use kmeans, k=50 for the clustering algorithm.

```
python main.py --train_path dataset-modified/train --test_path
dataset-modified/test --no_clusters 50 --clustering_alg kmeans
--feature_extraction kp
```

Running the code

Feature Extraction and Description

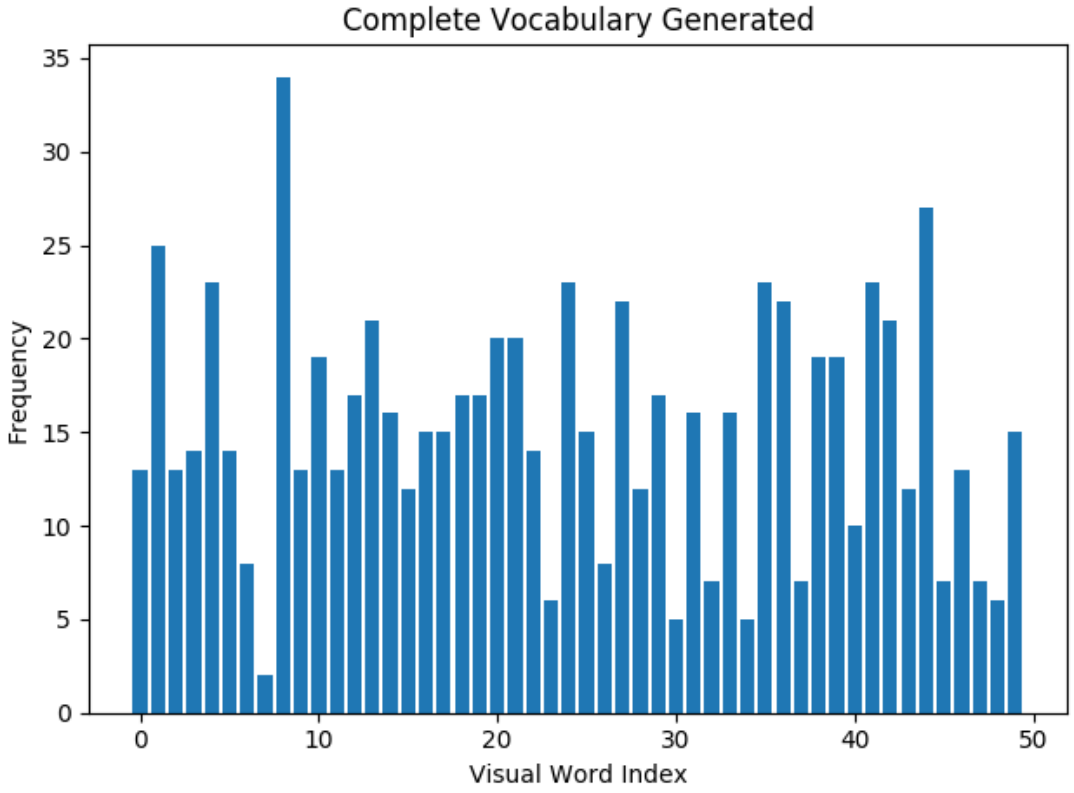
Scale invariant feature transform(SIFT) is a feature detection algorithm, to detect and describe local features in images. In order to apply SIFT, I first extracted the features of the train images using two different methods. I first detected keypoints in each image using sift.detectAndCompute and than constructed a keypoint array with iterating over the image using two different step sizes, 15 and 10. For the grids, I used sift.compute.

SIFT with keypoints, grid with step_size = 15, grid with step_size = 10

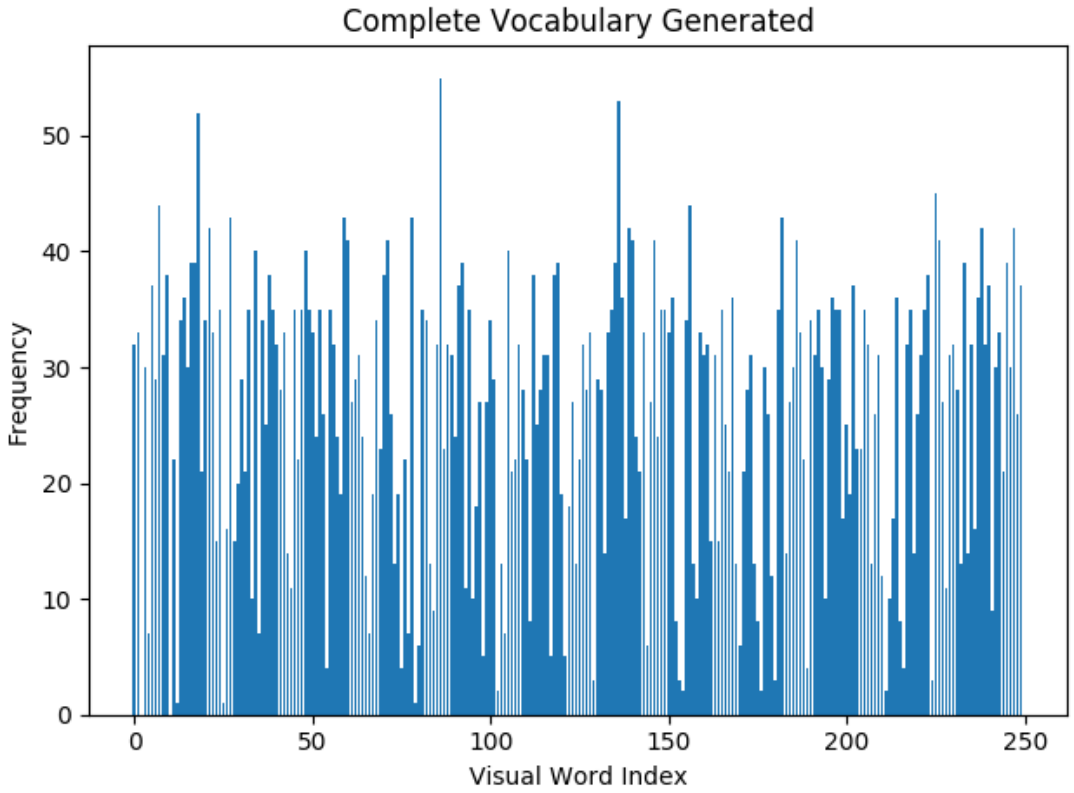
Dictionary Computation, Feature quantization and Histogram Calculation

After I got my descriptors, I vertically stacked all of them into an array and send the vertically stacked descriptors to my clustering algorithm. After I got my cluster, I created a histogram and ended up with the following vocablulary, for each experiment.

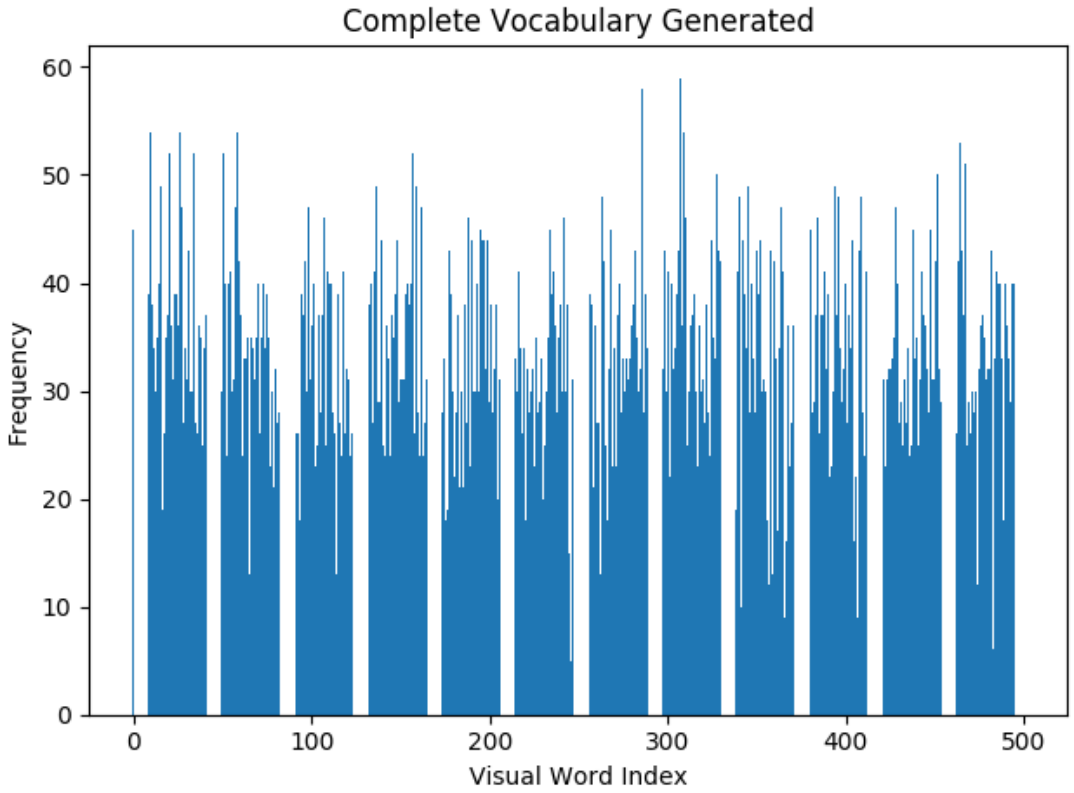
keypoints, k-means: k = 50



keypoints, k-means: k = 250



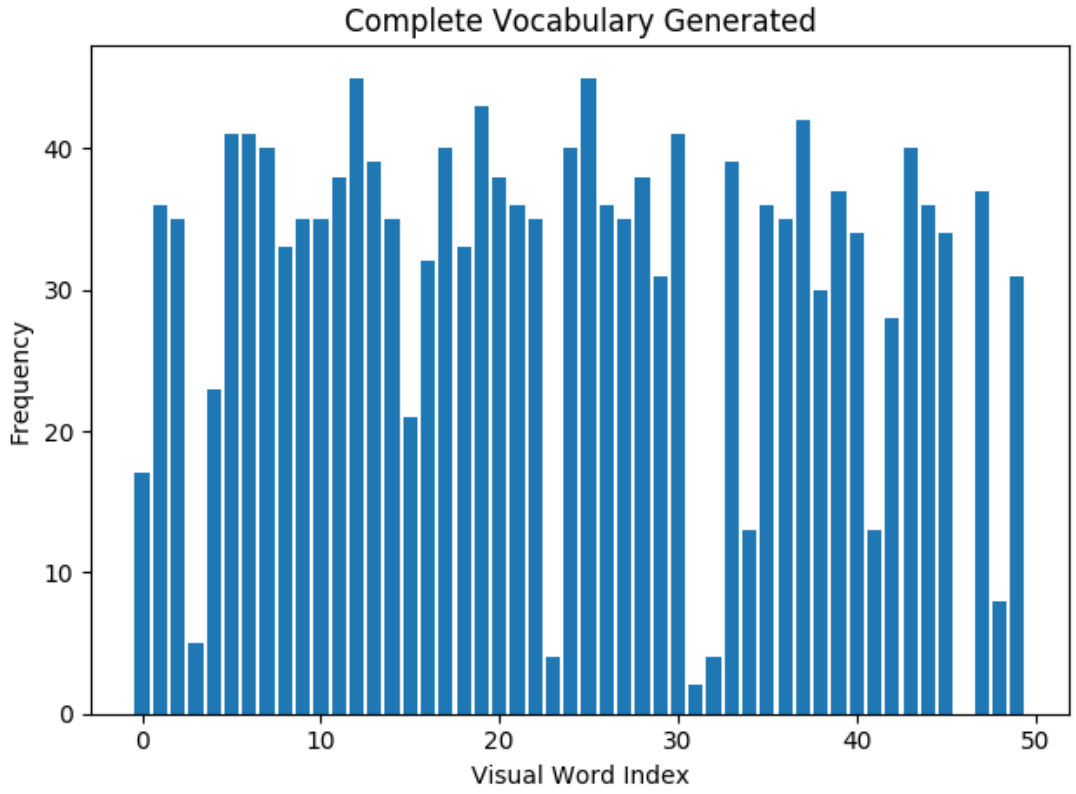
keypoints, k-means: k = 500



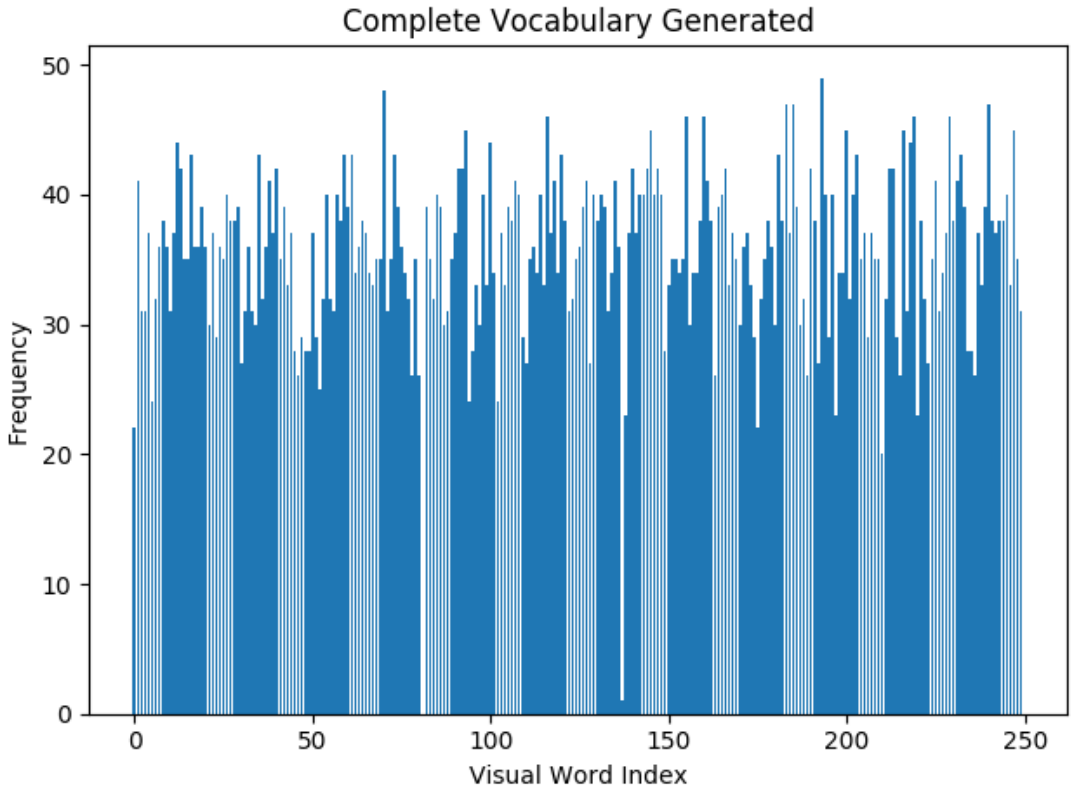
keypoints, k found by Mean Shift

keypoints, k-means: Meanshift found k

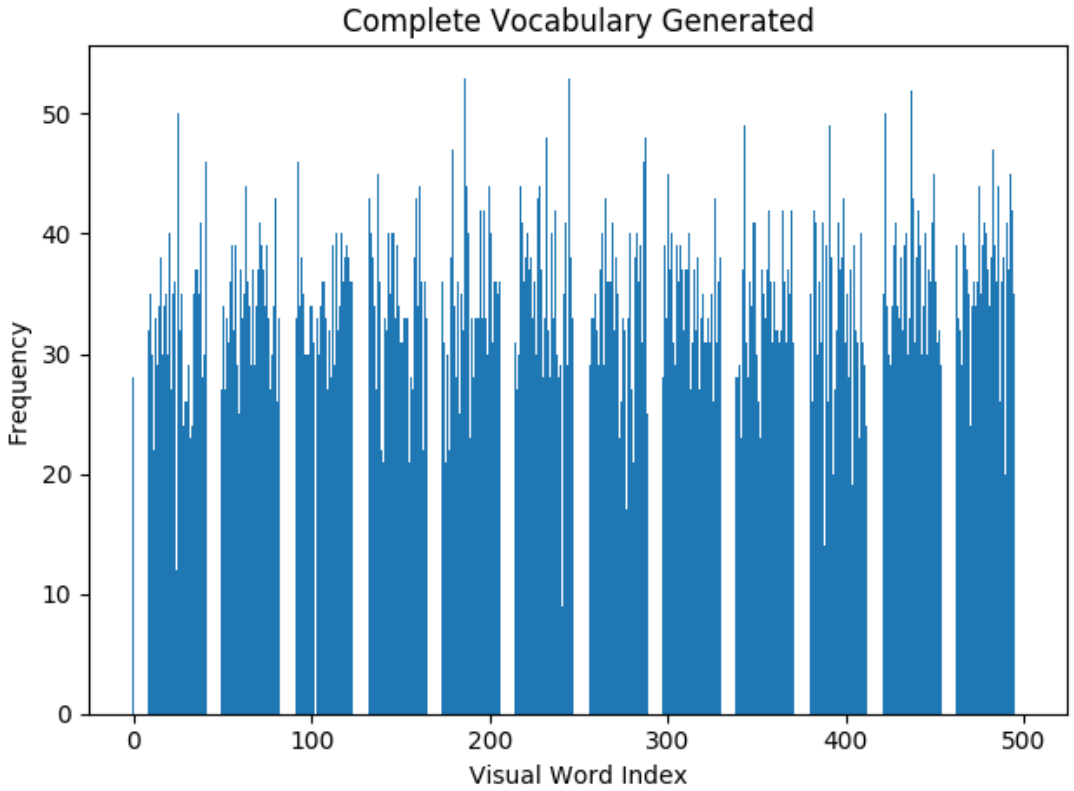
grid-1(step_size=15), k-means: k = 50



grid-1(step_size=15), k-means: k = 250



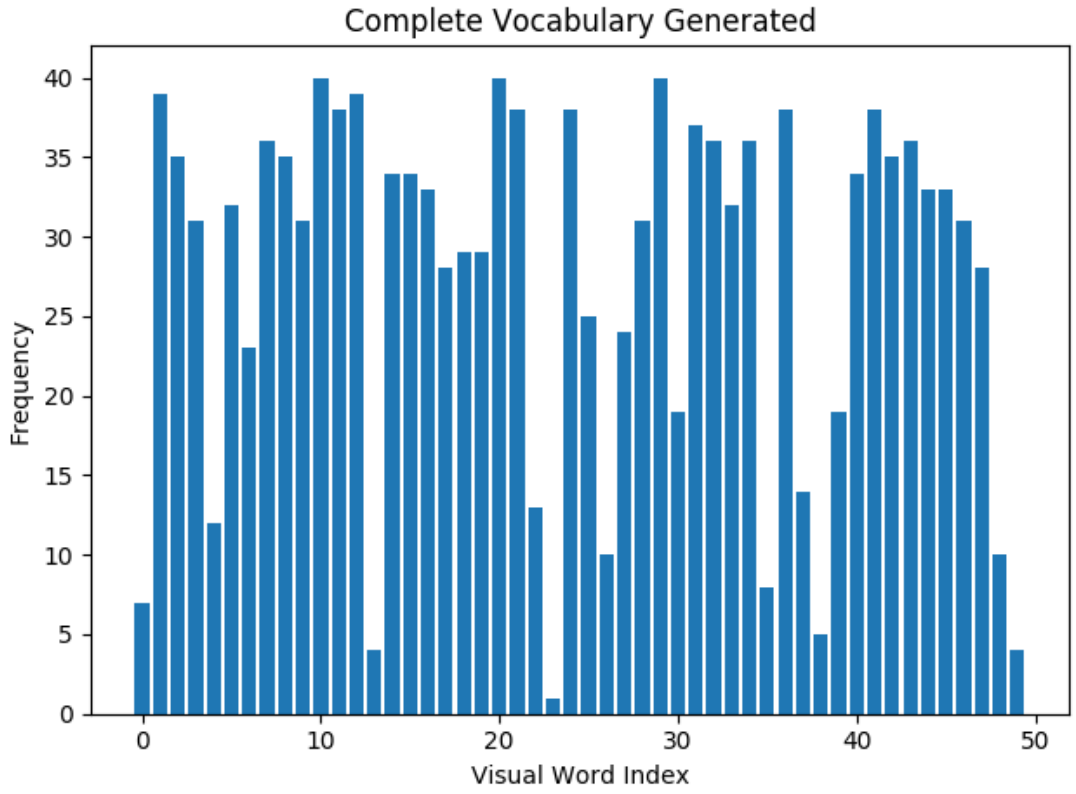
grid-1(step_size=15), k-means: k = 500



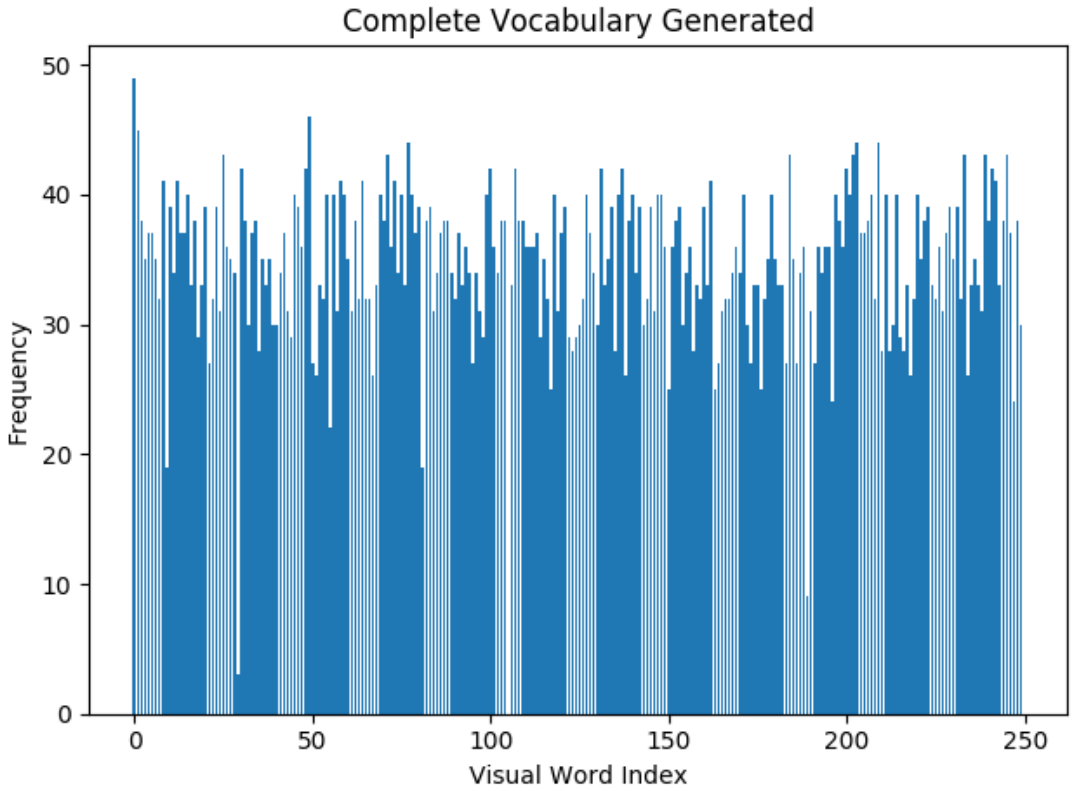
grid-1(step_size=15), k found by Mean Shift

grid-1(step_size=15), k-means: Meanshift found k

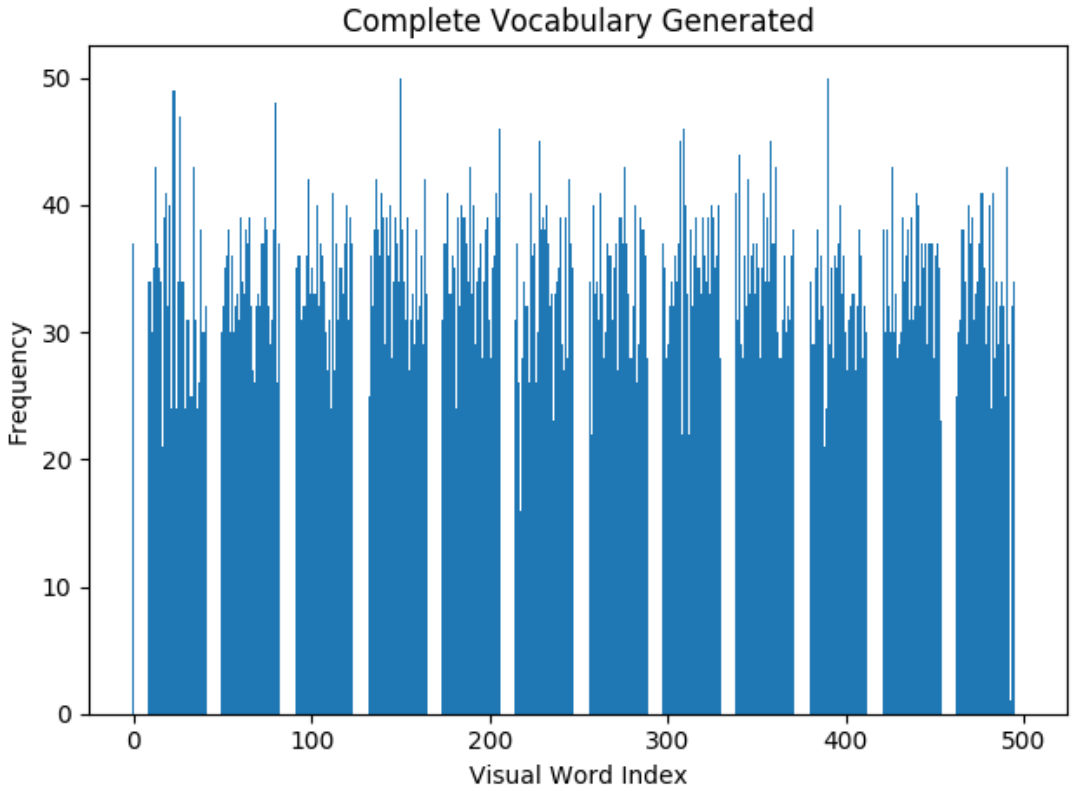
grid-2(step_size=10), k-means: k = 50



grid-2(step_size=10), k-means: k = 250



grid-2(step_size=10), k-means: k = 500

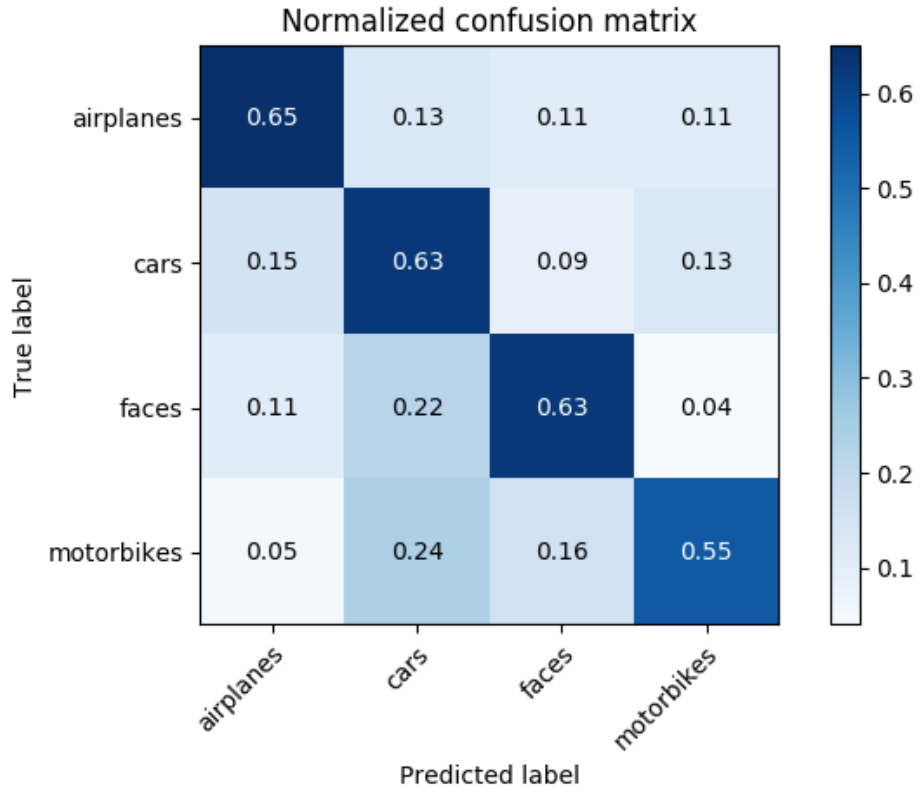


grid-2(step_size=10), k found by Mean Shift

grid-2(step_size=10), k-means: Meanshift found k

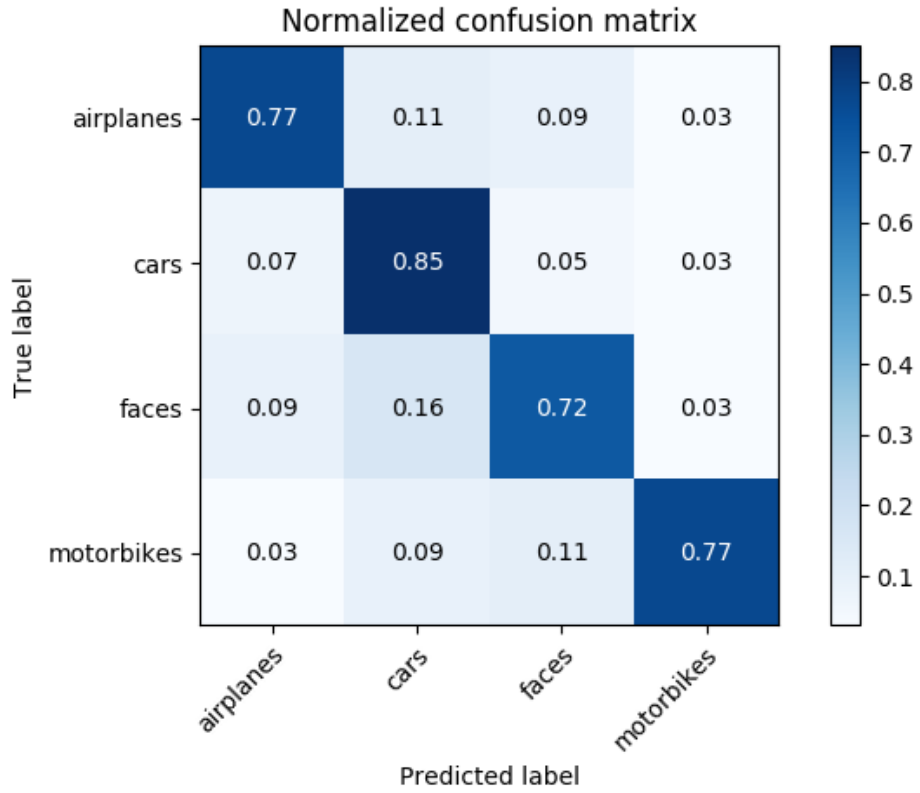
Results

keypoints, k-means: k = 50



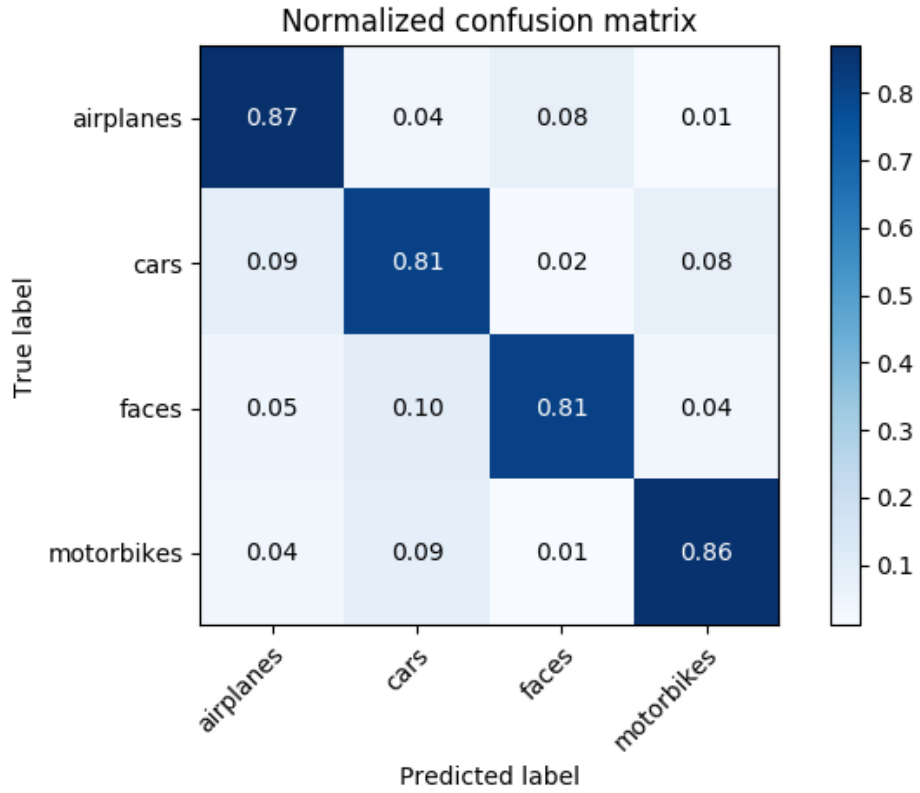
Accuracy: %66

keypoints, k-means: k = 250



Accuracy: %77.7

keypoints, k-means: k = 500

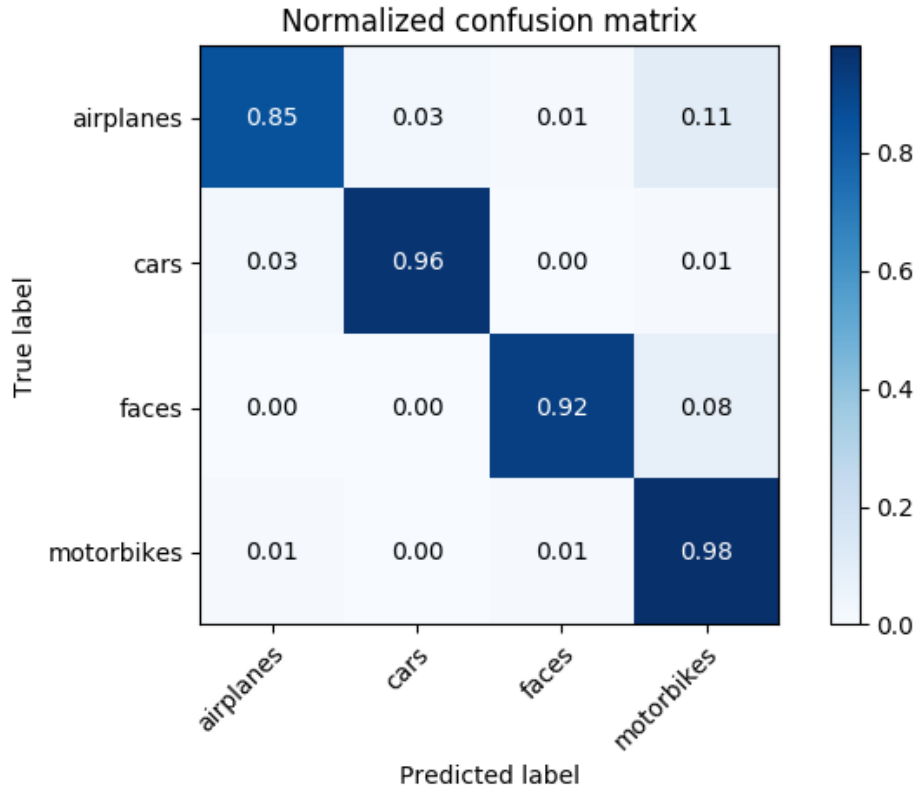


Accuracy: %83.8

keypoints, k found by Mean Shift

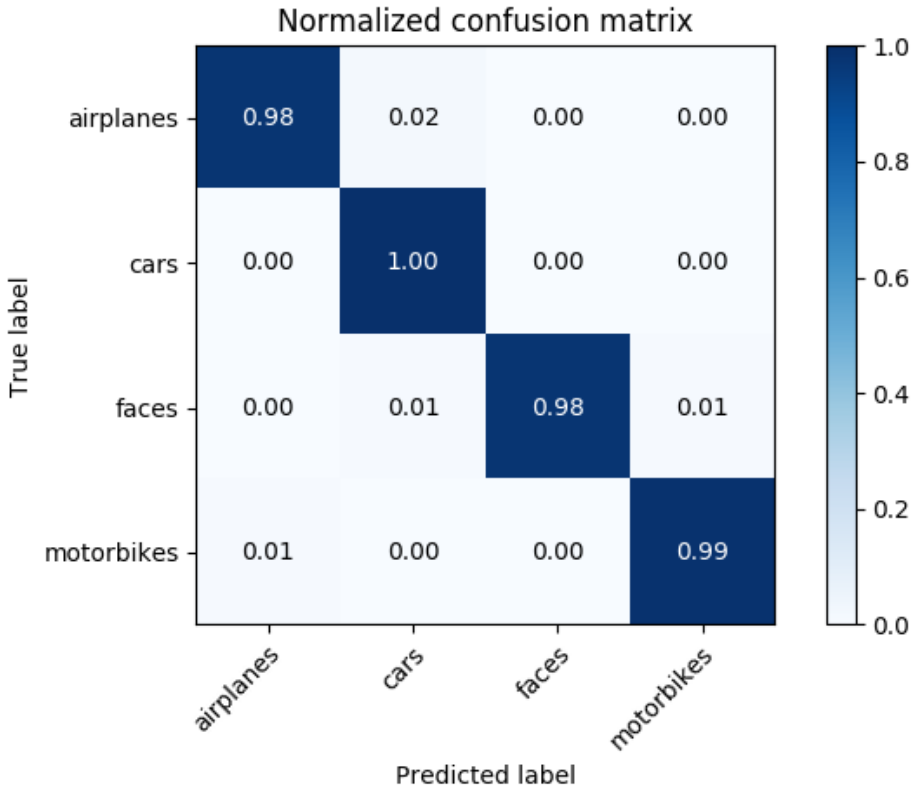
keypoints, k-means: Meanshift found k

grid-1(step_size=15), k-means: k = 50



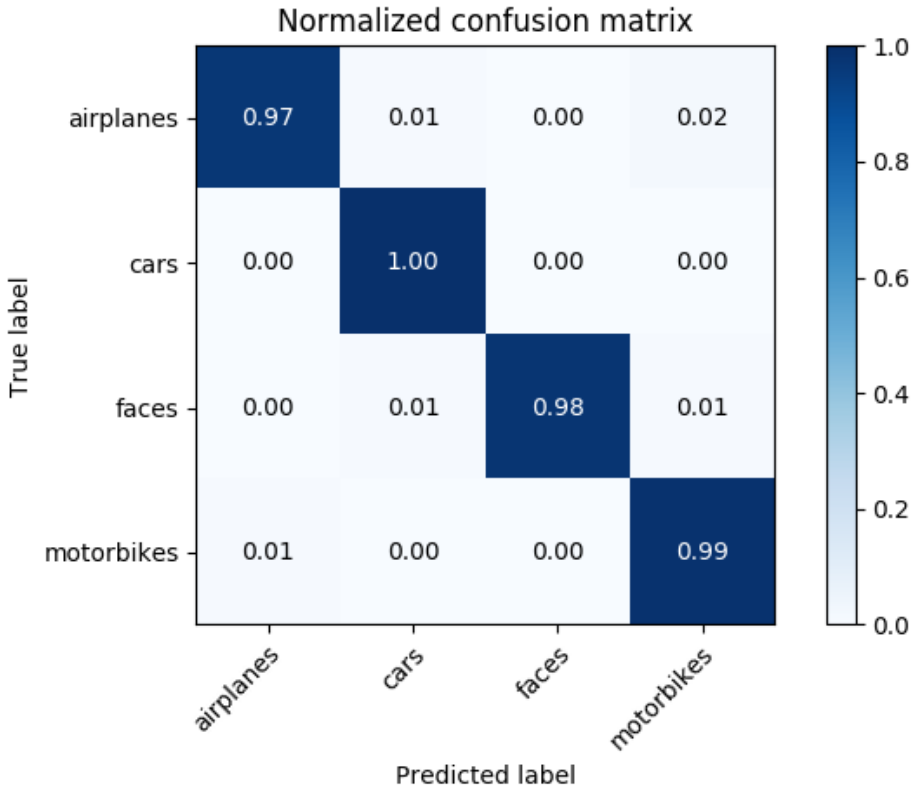
Accuracy: %92.7

grid-1(step_size=15), k-means: k = 250



Accuracy: %99

grid-1(step_size=15), k-means: k = 500

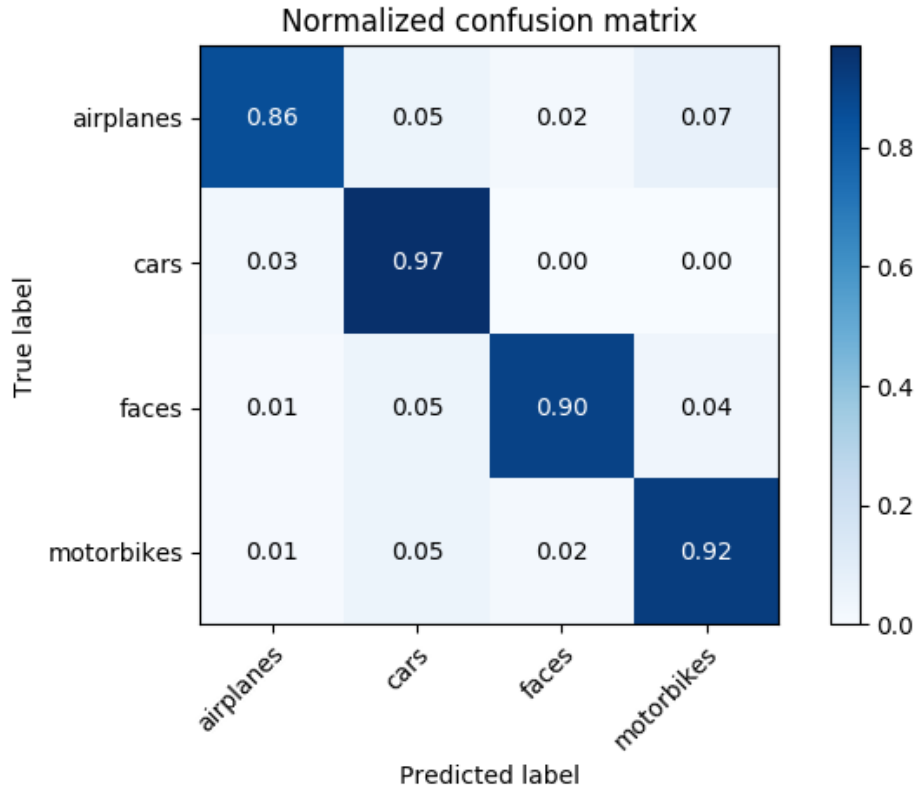


Accuracy: %98.5

grid-1(step_size=15), k found by Mean Shift

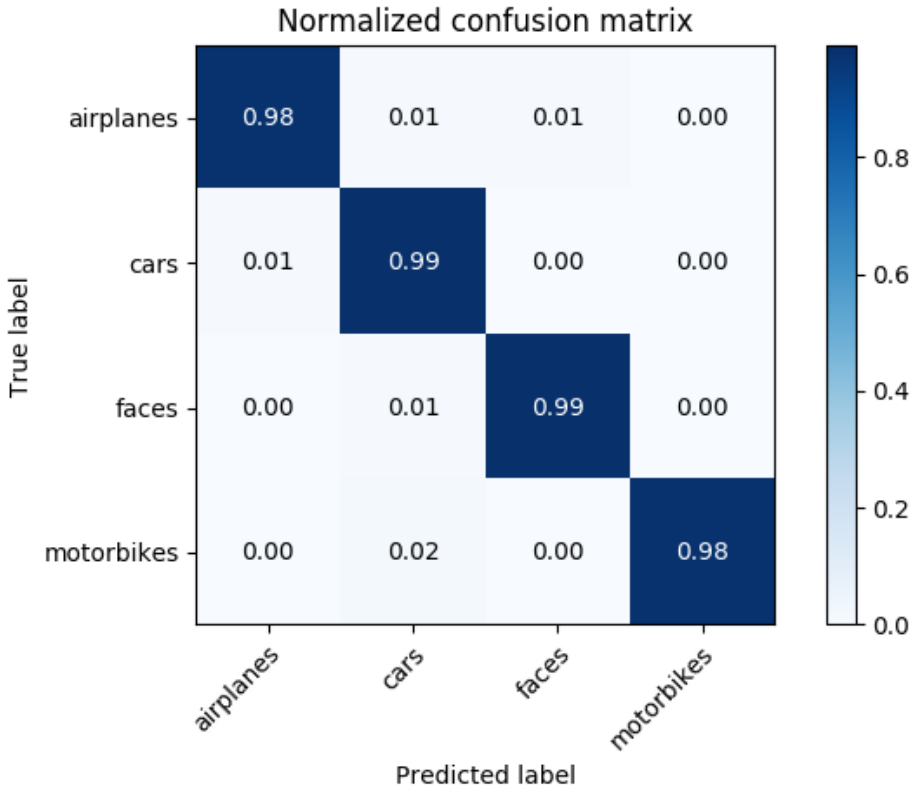
grid-1(step_size=15), k-means: Meanshift found k

grid-2(step_size=10), k-means: k = 50



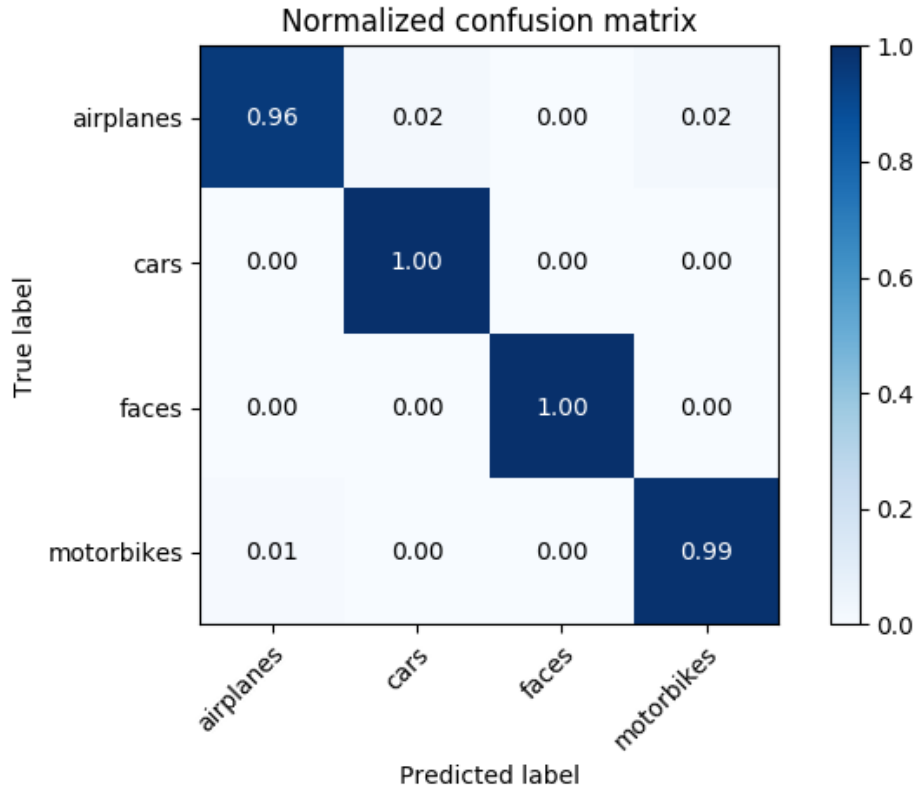
Accuracy: %91.2

grid-2(step_size=10), k-means: k = 250



Accuracy: %98.5

grid-2(step_size=10), k-means: k = 500



Accuracy: %98.8

grid-2(step_size=10), k found by Mean Shift

grid-2(step_size=10), k-means: Meanshift found k

Comments