DEPARTMENT OF COMPUTER SCIENCE

Assignment 3: Bag of Words

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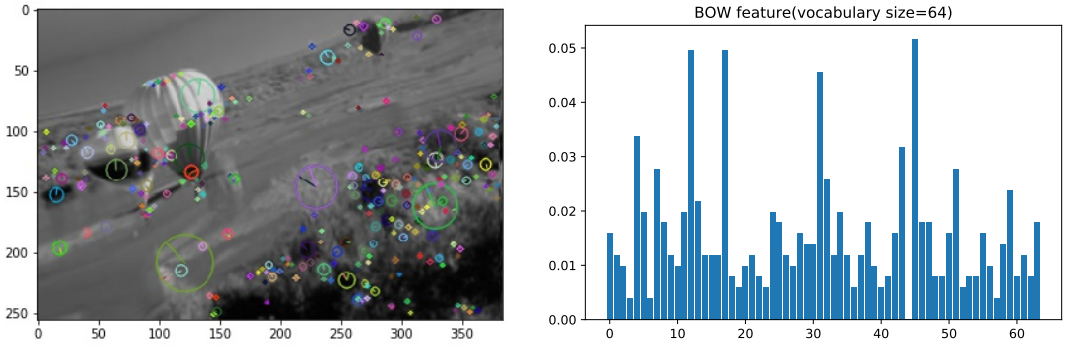
1 Introduction

Overall, the algorithm follows as:

1. build the vocabulary by k-means
   a) extract SIFT features from all the training images
   b) random sample a port of the SIFT features for the computational efficiency
   c) run k-means clustering on sampled features
   d) select the centers from the clustering as bag of visual words in the vocabulary
2. build the knn classifier
   a) extract the SIFT features from all the training images

Features	Distance Metrics	Accuracy
BOW	Euclidean	0.213
BOW	Manhattan	0.213
Color	Euclidean	0.320
Color	Manhattan	0.460
BOW+Color	Euclidean	0.367
BOW+Color	**Manhattan**	**0.520**

Table 1: Experiment results



(a) SIFT key points and their scale

(b) BOW(bag of visual words) features

Figure 1: Sample Image

b) assign the features to nearest visual words

c) use the normalized count histogram of the visual words as the BOW features

d) (optional)extract color histogram from the images as global Color features

e) construct knn classifier from the training features

3. test by knn classifier

a) extract features as in training images

b) get the K nearst neighbors of training images in feature space

c) use majority vote as the final prediction

2 Algorithms

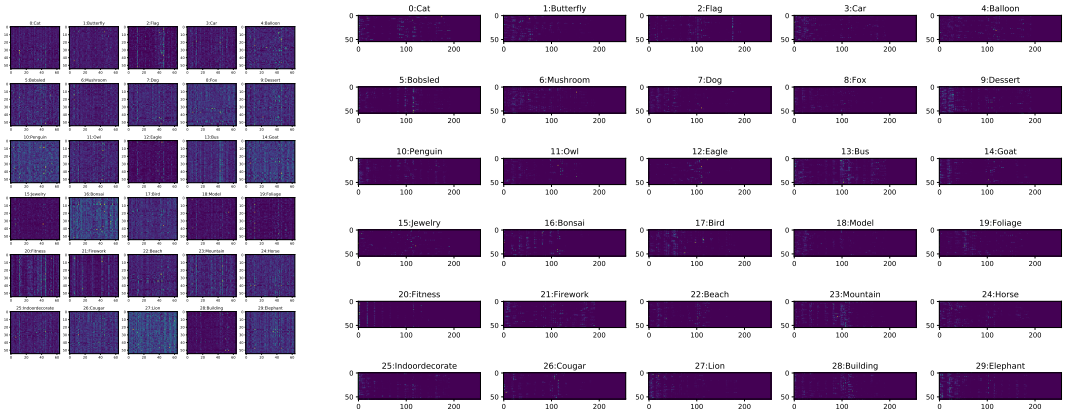
2.1 Extract SIFT features from all the training images

Use cale-invariant feature transform(SIFT) to extract 128-dimension feature vectors from all the training images. The SIFT key points and their scale of the sample image can be seen from Fig. 1a.

2.2 Build Visual Vocabulary and Extract BOW features

Run k-means clustering on the SIFT feature vectors extract above and use the centers as the bag of visual words in the visual vocabulary. For the image level representation related to the visual vocabulary, use the normalized count histogram of cluster assignment from the SIFT features, see Fig. 1b.

The class spectrum of BOW features is shown in Fig. 2a.



(a) The class spectrum of BOW features

(b) The class spectrum of color features

Figure 2: Class Spectrum

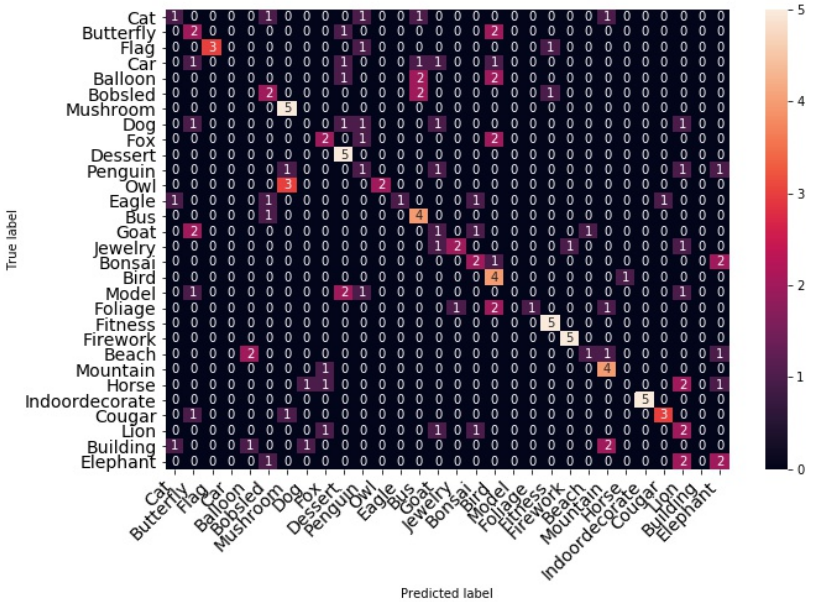


Figure 3: The confusion matrix of the KNN classifer.

2.3 Extract Color Features

Calculate a 3-dimensional color histogram from the HSV color space to represent the global color features. I note that this step is optional for general dataset but would be a great help in this dataset from the experiments. The class spectrum of color features is shown in Fig. 2b.

2.4 Build KNN Classifier and Run the Inference

Build a KNN classifier in extracted feature space of training images. Find the K nearest neighbors from the training images and use a majority vote as the classification prediction. The confusion matrix of the classifier is in Fig. 3.

3 Experiment Results

As shown in 1, color features and Manhattan distance in KNN contribute a lot to the best result.