Nonparametric Scene Parsing

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**Abstract**

Scene parsing is the problem of assigning a semantic label to every pixel in an image. This work adopts mid-level windows that are designed to capture entire objects, instead of low-level superpixels that tend to fragment objects. Rather than training a classifier for each class, we use a nonparametric method to tackle this problem. Besides, low per-class accuracy is a problem that most of scene parsing work faced. Through this project we aim to increase both per-pixel and per-class accuracy.

# Introduction

Computer vision enables us to understand scenes at many different levels of abstraction.

## Language

All manuscripts must be in English.

# Proposed Method

We use Caffe [1] to extract features of every image and regions in images. Caffe was created by Yangqing Jia during his PhD at UC Berkeley, it is a deep learning framework developed with cleanliness, readability, and speed in mind. Many works get impressive performance by using Caffe to extract features. This is why we use it to get features. In order to speed up, we extract all features for every image and region beforehand.

Our method can be divided to three steps. First, we retrieve images which are similar to query from training dataset. For every region in query image, we get similar regions that possibly contain correct label from retrieval set. Then we resize retrieval regions and directly paste the labels to the corresponding position in query. For the last step, we smooth the labels with an MRF function.

## Image retrieval

In this part, we want to retrieve k most similar images to the query. Because the features are already off-lined extracted, we can directly use Euclidean distance to measure similarity between training image and the query. After that, we rank the similarity and then choose k most similar as image retrieval set.

## Region retrieval

Since we want to get more complete objects, we use windows to locate possible regions that may contain the target. We use RCNN to obtain object proposals both in retrieval images and the query. This step is also done off-lined.

For each region in the query, we get k most similar regions from retrieval set. Euclidean distance is used as similarity measurement.

## Label Propagate

The final label result will be determined by minimizing the following energy function:

The first part of the energy function is unary term. It can be written as:

where

is window similarity, formed by RBF distance between color features of and , where is the query window that pixel p locates in, is the retrieval windows, and is a parameter. The higher similarity between the query and retrieval region, it is more possible that these two windows share the same labels.

is term frequency for class appearing in the retrieval images, where is the number of pixels, and is a parameter.

is the size of retrieval window. The reason why we use this term is that the smaller window tends to precisely locate the object at center.

The second part of the energy function is binary term. First we use blablabla method to get label co-occurrence, which means the probability that two labels are neighbors. For two adjacent pixels, if they belong to different labels and two labels seldom appear together in reality, the binary term will impose a penalty.

To obtain the final labeling, we can simply take the highest scoring label at each pixel, but this produces noisy results. We smooth the labels with an MRF energy function.

# Experiments

# Conclusion

## References

1. Y. Jia, E. Shelhamer, J. Donahue, S. Karayev, J. Long, R. Girshick, S. Guadarrama, and T. Darrell. Caffe: Convolutional architecture for fast feature embedding. arXiv preprint arXiv:1408.5093, 2014.
2. F. Tung, and J. J. Little, CollageParsing: Nonparametric scene parsing by adaptive overlapping windows. In *ECCV*, 2014.
3. J. Yang, B. Price, S. Cohen, and M.-H. Yang, “Context driven scene parsing with attention to rare classes,” In *CVPR*, 2014.

Figure 2: Short captions should be centred.