

BIL 415 - Image Processing Practicum



HACETTEPE UNIVERSITY

Department of Computer Engineering

Problem Set 4

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K-Means Clustering for Image Segmentation

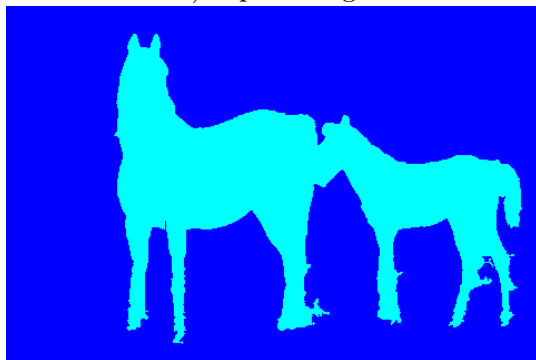
Due Date: 23:59pm on Monday, January 6th, 2014



a) Input Image



b) Superpixels



c) Image Labels



d) Image Segments

Figure 1: K-Means Image Segmentation using Superpixels

Background

Clustering is a process that groups data with respect to data similarity so that similar data take part same cluster. In image domain clustering is used for various types of problem e.g. *image quantization*, *image segmentation*. A good clustering algorithm must group data to homogeneous subsets as possible. Similarity is most critical step in a clustering algorithm that determine how the clustering algorithm groups data. K-means clustering is one of the most popular clustering algorithm that groups data to k dissimilar clusters. It is an unsupervised learning algorithm for clustering problem and the main idea is to define k centroids one of each cluster. These centroids is randomly assigned to data space for first iteration. In the next steps, for each data point, distance to these centroids is calculated and data points are assigned to nearest centroids as cluster elements. Then for each cluster, new k centroids are calculated from k clusters. This steps go on until clusters centroids unchange.

Overview

In this assignment, you will use k-means clustering algorithm for image segmentation by using superpixel representation of an input image. For this purpose you must carry out the following steps:

- Extracts Superpixels
You will use SLIC Superpixel work to extract superpixel labels. You can find the code in <http://ivrg.epfl.ch/research/superpixels>
- Feature Representation of Each Superpixel
You will define a feature vector to represent each superpixel. This feature vector may contain various type of features such as color, intensity, location or 1st order statistics of these features in superpixels e.g. *means of intensities*. You will build up your own feature representation.
- K-Means Clustering of Superpixels
You can use Matlab built-in function for k-means clustering. You will give feature points obtained from each superpixel and cluster number to k-means algorithm so that k-means algorithm will produce cluster labels for each superpixel.

Details

Your Matlab program will take an color or gray level image and cluster number as input and produce segmentation result like in Figure 1-c,1-d.

-You must take results on the least 5 images. You can find lots of image in Berkeley Segmentation Dataset[2].

-You must play with cluster number according to the image content to obtain good results.

-You must use superpixels with different region size like in Figure 2 and make observation that how the superpixels and region size of superpixels influence clustering results or not.

-You must show your results like in Figure 1-c,1-d. You can use *imagesc* function in Matlab for this purpose.

-You must comment your results why they are satisfactory or not.

What to Hand In

You are required to submit all your report along with a short webpage in *HTML*. For that purpose, prepare a folder containing

- `README.txt` (*text file containing details about your project*)
- `code/` (*directory containing all your code*)
- `HTML/` (*directory containing all your documents, including your images*)
- `HTML/data/` (*including your data images*)
- `HTML/result/` (*including your result images*)
- `HTML/index.html` (*html report*)

Archive this folder as `pset5.zip` and send to `karacan@cs.hacettepe.edu.tr`.

In this assignment you will write detailed report which contains a brief overview of the problem, details of your implementation and the results with your comments. You must play with related parameters. All results you obtain must be put to your report and all observations must be specified clearly. Analyzing the results with appropriate comments you will do is important for this assignment.

If your algorithm failed to give a satisfactory result on a particular image, provide a brief explanation of the reason(s).

References

- [1] <http://ivrg.epfl.ch/research/superpixels>
- [2] <https://www.eecs.berkeley.edu/Research/Projects/CS/vision/bsds/>.