Answers to questions in

Lab 3: Image segmentation

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**Instructions**: Complete the lab according to the instructions in the notes and respond to the questions stated below. Keep the answers short and focus on what is essential. Illustrate with figures only when explicitly requested.

Good luck!

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**Question 1**: How did you initialize the clustering process and why do you believe this was a good method of doing it?

Answers:

We initialize the clustering using unique colors that are present in the image. We believe this is a good method because then our initial colors will be close to the final colors and each mean will at least have one pixel assigned to it, avoiding division by zero.

**Question 2**: How many iterations L do you typically need to reach convergence, that is the point where no additional iterations will affect the end results?

Answers:

We typically need around 40 iterations to converge on the orange image. We need more iterations if a higher K is chosen. We measure convergence by number of pixels that change their assigned center, if this number is zero we have converged.

**Question 3**: What is the minimum value for K that you can use and still get no superpixel that covers parts from both halves of the orange? Illustrate with a figure.

Answers:

K equal to 8 manage to separate the halves.

**Question 4**: What needs to be changed in the parameters to get suitable superpixels for the tiger images as well?

Answers:

On the orange pic, we can get away with very small K if we do not care about dividing the two oranges. Tigers are more difficuly since they have stripes, so we increase K to 4-5 for the tiger images and add smoothing to the images.

**Question 5**: How do the results change depending on the bandwidths? What settings did you prefer for the different images? Illustrate with an example image with the parameter that you think are suitable for that image.

Answers:

On images where colour is saying how the segmentation should be done, a low colour bandwidth should be used. Increasing the colour bandwidth makes pixels with different colours more similar. Same thing goes for the spatial bandwidth. Spatial bandwidth works similarly to a radius around each pixel to use for calculating the gradients.

**Question 6**: What kind of similarities and differences do you see between K-means and mean-shift segmentation?

Answers:

K-means segmentation looks smoother than mean-shift. K-means does not care about the position of pixels which mean-shift does.

**Question 7**: Does the ideal parameter setting vary depending on the images? If you look at the images, can you see a reason why the ideal settings might differ? Illustrate with an example image with the parameters you prefer for that image.

Answers:

If the foreground does not stand out from the background a lower color bandwidth is required.

Cut threshold can be set to fairly low with respect to the average cut value the program prints. This results in fewer cuts but keeps the most significant ones.

**Question 8**: Which parameter(s) was most effective for reducing the subdivision and still result in a satisfactory segmentation?

Answers:

The cutting threshold was very effective in reducing the amount of subdivisions when using a high maximum depth.

**Question 9**: Why does Normalized Cut prefer cuts of approximately equal size? Does this happen in practice?

Answers:

The Ncut formula minimizes when assoc(A,V) and assoc(B,V) are the same size. If A + B would be an area of the same color, Ncut would minimize when A and B are exactly the same size. This is easily shown in a completely white image. Each cut is done by dividing the set in half. Here all weights are equal.

**Question 10**: Did you manage to increase *radius* and how did it affect the results?

Answers:

Increasing the radius from 3 to 5 on our previous Orange pic improves the result by removing subdivisions.

**Question 11**: Does the ideal choice of *alpha* and *sigma* vary a lot between different images? Illustrate with an example image with the parameters you prefer.

Answers:

Compared with the other methods used in this lab Graph Cuts is least sensitive to parameters. You still get good result with non ideal parameters.

**Question 12**: How much can you lower K until the results get considerably worse?

Answers:

K can go as low as 4 and still get a satisfactory result on the tiger images. The orange image performs at best with K = 1. K depends on how much unique colours the foreground contains compared to the background.

**Question 13**: Unlike the earlier method Graph Cut segmentation relies on some input from a user for defining a rectangle. Is the benefit you get of this worth the effort? Motivate!

Answers:

Graph Cuts get considerably better result than the previous method. However it relies on human input. This makes the method worse in the scenarios when you do not have the resources to have an human pre-label each image. However you do not need to label each image separately a trained model on one image will preform well on similar images.

**Question 14**: What are the key differences and similarities between the segmentation methods (K-means, Mean-shift, Normalized Cut and energy-based segmentation with Graph Cuts) in this lab? Think carefully!!

Answers:

Graph cut is very different because it requires a prior input. K-means and Graph Cuts does not take into account spatial information, which the other methods do. K-means also require you to choose how many colours the image should have, which the other methods does not. Normalized cuts and Graph Cuts construct a graph of the image with weights corresponding to similarities between the pixels.