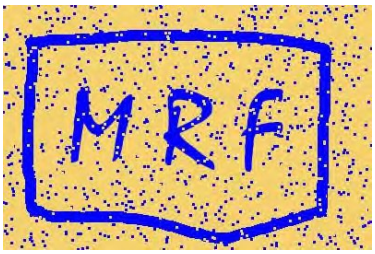
Assignment II: Markov Random Field and Graphcuts

In this assignment, you'll first make use of binary graphcuts to clean up noise in an image consists of only two colors. Then you're required to apply multi-label graphcuts to do color segmentation on images provided to you.

Part I. Noise cleaning



The above image consists mainly of background color (245, 210, 110) and foreground color (0, 0,255). The background is contaminated with pepper noise in the same color as the foreground. Write a piece of program to clean up the noise using binary graphcuts. You can download the code of binary graphcuts from the following links:

http://vision.csd.uwo.ca/code/maxflow-v3.01.zip (C++)

http://vision.csd.uwo.ca/wiki/vision/upload/d/d7/Bk_matlab.zip (matlab)

Pseudocode for constructing a simple binary graphcuts problem on an image grid is given bellow.

```
foreground_color = [255, 0, 0];
background_color = [110, 210, 245];
for (int y = 0; y < H-1; y++) {
    for (int x = 0; x < W-1; x++) {
          c = image_color at (y, x);
          node = y * W + x;
          //data term
          graph->add_tweights(node, dist(foreground_color, c), dist(background_color, c));

         //smoothness term
         next_node = y*W + (x+1); //neighbor to the right
          graph->add_edge(node, next_node, m_labmda, m_lambda);
          next_node = (y+1)*W + x; //neighbor below
          graph->add_edge(node, next_node, m_lambda, m_lambda);
  }
}
graph->maxflow();
```

Display the cleaned image according the labeling results and include it in your report. You may need to try different settings of m_lambda to obtain a good result.

Part II. color segmentation

First, implement K-mean clustering to initialize the segmentation, and to obtain K-center colors. The user should be able to enter the value of K (the number of the segmented colors).

Then, build MRFs with multilabels and optimize by using the multilabel graphcuts. In the multilabel graphcuts, you should define the smoothness cost when two labels are the same (e.g. cost = 0) and when they are different (e.g. cost = 1). The data cost can be defined as the distance between the pixel color to each of the K-center colors.

Code of multilabel graphcuts can be downloaded from:

http://vision.csd.uwo.ca/code/gco-v3.0.zip (C++&matlab)

Include the segmentation results on the given images with different settings of K, discuss the drawbacks of the algorithm in your report. How can you improve the algorithm?

You are required to submit both of your source code (matlab or C/C++) and report together. Please upload your softcopy to the IVLE submission folder, and include your student ID in the file name. Write clear remarks or comments on your source code.