6.815/6.865 Digital & Computational Photography

Problem Set 4: Matting

Due Friday, March 11 at 7:00pm

Matting

Matting refers to the process of separating the foreground and background elements of an image, generally for the purpose of compositing. A variety of methods have been proposed to solve this difficult and underconstrained task. In this assignment, you will be implementing a simplified version of Chuang et al.'s Bayesian technique from CVPR 2001: `http://grail.cs.washington.edu/projects/digital-matting/image-matting/`.

The user provides an input image and a corresponding *trimap* which coarsely classifies each pixel as foreground, background, and unknown. The known information from the foreground and background pixels is then used to estimate the color and transparency of the unknown pixels. This is done as follows:

- Model the color statistics of foreground and background using three-dimensional Gaussian distributions in RGB space. Note that Chuang et al. model both the foreground and background using multiple Gaussians each (a Gaussian Mixture Model) to create local estimates of the likelihoods. For this assignment, assume that the distributions are spatially invariant. In other words, you only need to compute two Gaussians—one for the foreground pixels, and another for the background pixels.
- For each unknown pixel, compute a *maximum a posteriori* estimate of the foreground color, background color, and alpha channel. This is achieved using an iterative optimization which is described in the paper and lecture notes.

Problem 1 (6.815/6882)

Implement the simplified matting technique described above and apply it to the provided images. Specifically, you should compute a matte for `toy.jpg` using the trimap `trimap.png` and composite your result with `bookshelf.jpg`. The provided image, along with the desired result, is shown below.

One thing you should notice about *toy.jpg* is that the foreground and background are both fairly uniform in color. This is why the simplified technique works well, even though it would be too simplified for more general cases.

Place your implementation in a script called `matting.m`. It doesn't have to be a neatly abstracted function or anything. If you'd like, you can even hardcode the image dimensions. The results shown on the previous page were achieved using an initial α of 0.5 for all unknown pixels, $\sigma_C = 0.01$, and 20 iterations. It's not a very fast algorithm—maybe a few minutes for the given parameters—so don't be alarmed if your code seems slow at first.

In your writeup: Paste images of your alpha matte and composite. You may also want to summarize the path you took to get your results.

Submission

Like the previous assignment, you should assemble a ZIP file that is named after your Athena login. Make sure this file contains:

- A PDF file containing your write-up
- Your MATLAB code:
  - `matting.m`
- Any images (other than the provided ones) that might be necessary to run your code.

All electronic submissions are due on the Stellar website by March 11 at 7pm.