Project #4:

Image foreground/background segmentation using max-flow

A basic problem in computer vision is how to segment objects in images. In class we will discuss segmenting the foreground from the background in an image. This problem is generally treated as a clustering problem, where the pixels are clustered into two groups (foreground or background).

Max flow algorithms can be used as way to solve the segmentation problem efficiently in the case of two segments. In order to actually implement the algorithm, one requires for every pixel a likelihood for the pixel to be assigned to the foreground or the background. Typically this is done by using an off-the-shelf clustering algorithm based the color (e.g., RGB values) of the pixels, such as k-means or Gaussian mixtures; existing code can be used for this step. This requires that selected regions of the image be labeled as background, and other regions as foreground. A good reference paper on this is:

Y. Boykov and M. P. Jolly. Interactive graph cuts for optimal boundary and region segmentation of objects in N-D images. In ICCV, volume 1, pages 105–112, July 2001.

A more recent paper implementing this is in

https://www.dip.ee.uct.ac.za/~nicolls/publish/mk09-prasa.pdf

As input, you will receive gray scale jpeg images of variable size. You must develop a way of interactively selecting a region of background pixels and another region of foreground pixels for training data that will be used to estimate a probability model based on intensity for both background and foreground pixels. You will also need to specify an appropriate model for the energy required to separate neighboring pixels into different classes. With these you can formulate the problem as a min cut problem, which can be solved using max-flow algorithms (which you must implement).

Minimum Requirements [55%]

- Command line user interface that lets user identify image

  - Graphical interface to let the user specify parts of foreground, background regions for
  - training
  - Algorithms for computing most likely segmentation based on max flow
  - Graphical display of segmentation output highlighting foreground and background regions.

Possible Extensions [15%]

- Develop a GUI [15%]

Comparative Features [30%]

- Exploration of the effect of alternative models for foreground/background likelihoods
- Exploration of the effects of alternative separation energy models
- Speed of key operations