Computer Vision
Spring - 2021
Assignment 3 - MRFs for Image Segmentation
Posted on: 05/03/2021
Due on: 23:59hrs, 16/03/2021
TAs - Rohan, Prajwal

Guidelines

1. Follow the specified repository structure. `src` folder will contain the Jupyter notebooks used for the assignment. `images` folder will contain any images used for the questions.
2. Commit your work regularly to avoid losing progress. Make sure you run your Jupyter notebook before committing, to save all outputs.
3. The report should contain description of the problem, algorithms and results. It should be written in markdown, in the notebook itself.
4. Make sure that the assignment that you submit is your own work. **Any breach of this rule could result in serious actions including an F grade in the course**.
5. The experiments and report writing takes time. Start your work early and do not wait till the deadline.
6. You are not allowed to use inbuilt functions that directly solve the tasks assigned. Confirm with TAs regarding whether some function can be used, when in doubt.

Questions

1. **GrabCut**

    1. You will need to implement the GrabCut algorithm for this assignment. You are supposed to read and follow Rother et al paper. It will give you a detailed description of the algorithm.
    2. You only need to implement the iterative procedure described in Sec.3.1, Sec.3.2 and Sec.3.3 of the Rother paper to get a binary segmentation of the image. You do not need to implement border matting or foreground estimation in Sec.4.
    3. Please refer to Sec.2 of the Rother paper and the Boykov & Jolly paper for details regarding energy minimization based image segmentation.
    4. The provided boilerplate code implements the user interface. You can use GMM of standard libraries (sklearn etc) that would be required for implementing Sec.3.1
    5. You are also supposed to write a report that must include a study of how changes in the various parameters affects the segmentation. Choose any 3 from the below list. You could come up with meaningful parameters of your own as well.
        - The number of iterations of GMM updating and energy minimization.
        - The number of mixture components in your GMM.

- Whether to use soft GMM labels and do EM, and how that effects other parameters/results.
- Different ways to represent probabilities other than GMMs. 4-neighborhood or 8-neighborhood in your pairwise term.
- The choice of gamma.
- Alternative ways of setting beta.
- Effect of a tight initial bounding box or a loose bounding box.
- Better ways of using the bounding box for segmentation.
- Different color spaces or ways of representing pixels. Co-segmentation.

2. **Bonus: MRFs for Image denoising**

    1. Model and implement a MRF for image denoising
    2. The report must include results on noisy images and explain why the chosen potentials are useful for this task. You can take any image of your choice and add gaussian noise to test your implementation.
    3. Please include the code used in a new sub-directory `mrf` in the `src` directory. Bonus marks will be given based on the code and quality of results.