UNIVERSITÀ DI PISA

Assignment N. 4:

Image Segmentation via N-cut on the "tree dataset"

ISPR Course A.Y. 2020/2021
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Implementing the N-Cut Segmentation

Segmentation process implemented via Scikit-Image library functions:

- **Initial Segmentation via K-means :**
  - k_labels = segmentation.slic(image, compactness=**compactness**, n_segments=**n_segments**)
  - k_out = color.label2rgb(k_labels, image, kind='avg')
- **Computing the Region Adjacency Graph (RAG) :**
  - rag = graph.rag_mean_color(image, k_labels, mode='similarity')
- **Performing the Normalized-Cut :**
  - ncut_labels = graph.cut_normalized(k_labels, rag)
  - ncut_out = color.label2rgb(ncut_labels, image, kind='avg')

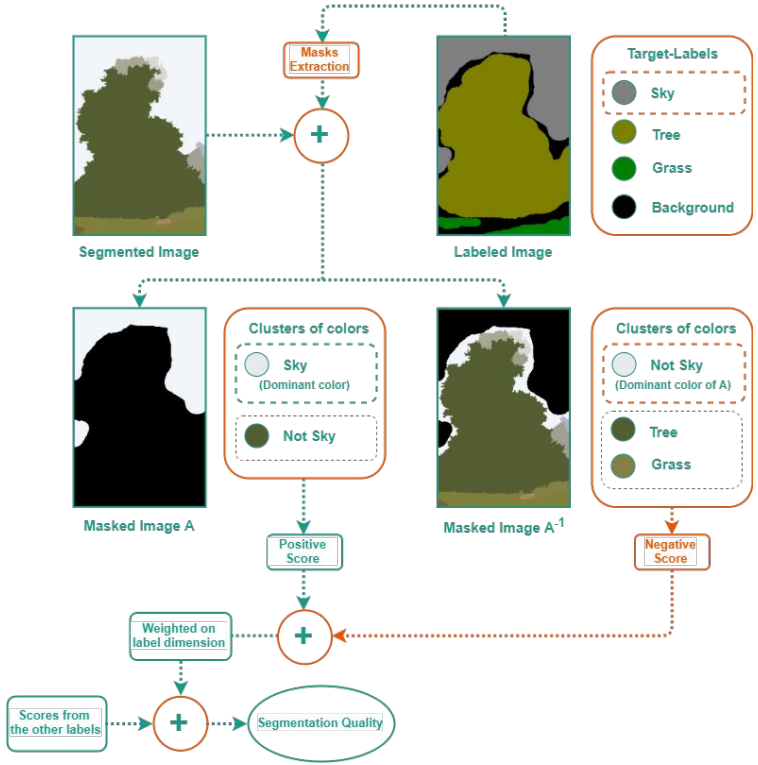
Identification of of ideal parameters for the segmentation:

- (**At first**) By visual comparison of several combination of parameters (Screening)
  - Somewhat inefficient approach
  - Need for a measure of the quality of a segmentation

Computing a Measure of the Segmentation Quality

For each **labeled area** on the **target image**:

1. **Extract the label-specific masks**
   - Area covered by the label
   - Area not covered by the target-label
2. **Apply the masks on the segmented image**
   - Obtain the masked images **A** and **A^{-1}**
3. **Compute the positive score on masked image A**
   - Select the dominant color of the image as **D_clr**
   - Compute the percentage of area covered by **D_clr** within the target-label region
4. **Compute the negative score on masked image A^{-1}**
   - Computing the percentage of the area covered by **D_clr** outside of the target-label region
5. **Sum the two scores and weight on the percentage of image covered by the target-label**
6. **Sum the scores for the remaining labels**
   - Ex: Score = Sky + Tree + Grass + Background



Analysing the results of the Segmentation

- **Improved Model selection:**
  - From visual comparison of k-means segmentations
  - To **grid-search approach** based on **average resemblance to labeled images**
- **Working on a unique set of parameters:**
  - Overall **average accuracy** around **50%**
  - **Dense Trees**: **60-80%**
  - **Sparse Trees**: around **40%**
- **Splitting the dataset in tree-shape subsets**
- **Working on subset specific parameters:**
  - **Higher number of segments** and **lower compactness** for **sparse trees**
  - **Average accuracy** over the whole dataset raised to **60%**

Final Considerations: Flaws and Improvements

- **Problematic Flaws / Conditions:**
  - Scattered and articulated forms
  - Areas shared by different non-easily separable colors
    - Ex. Sky through the branches
  - Asymmetrical influence of light on some objects
  - Scalability of the manual recognition of the shape of objects
- **Potential Improvements:**
  - Clustering for tree / object shape recognition
  - Adaptive use of different segmentations
    - Increasing the segments in areas of high color diversity