Exercise 04 for MA-INF 2201/MA-MOROB-M04 Computer Vision WS25/26
10.11.2025
Submission deadline on 23.11.2025

The folder data contains an image (*img_mosaic*.tif) obtained from a UAV. This image is a 8 bit TIFF file with three bands; the three RGB bands of the image correspond to the near infrared, red and green bands delivered by the UAV camera. The task is to develop a method to automatically extract building from this high-resolution remotely sensed image. Fig. 1 shows the results obtained by a baseline method.

1. Use basic image processing, segmentation and clustering techniques to obtain an initial segmentation mask similar to Fig. 1 (a). *(14 points)*

2. The next step is to refine the segmentation. Given a building candidate from the first step and its associated region on the image, propose an energy function E defined in a way such that its minimum corresponds to better segmentation and building candidate (Fig. 1 (b)). Implement the energy function by yourself and optimize it as you have learned in MA-INF 2201/MA-MOROB-M04. *(18 points)*

3. Construct the vectorized map. Vectorization converts the refined segmentation map into vector polygons based on prior knowledge regarding the geometric properties of buildings. For example, prior knowledge of the building geometry suggests that buildings have usually straight lines and 90° angles. Plot the coordinates and polygons similar to Fig. 1 (c). *(8 points)*

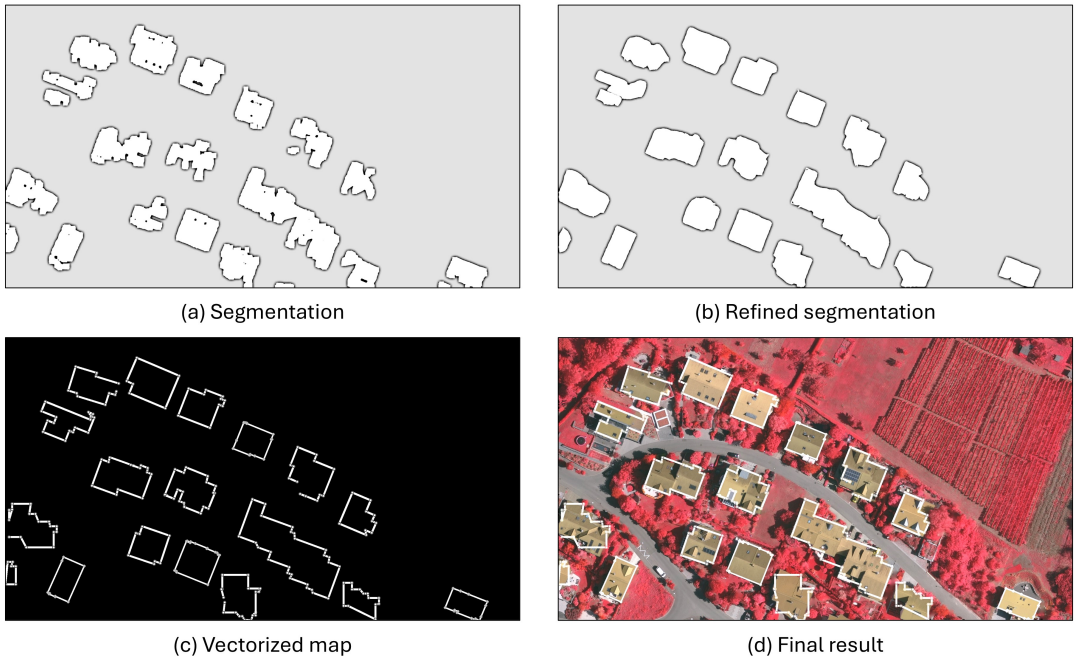

Figure 1: Overview of the exercise.

For this exercise, only use techniques from MA-INF 2201/MA-MOROB-M04 i.e., don't use machine learning. Compute the Intersection over Union (IoU) score for the refined segmentation. IoU is computed as the area of overlap between the predicted and target segments over the union area of the predicted and target segments: $\text{IoU}(prediction, target) = \frac{prediction \cap target}{prediction \cup target}$. The ground truth image (*img_mosaic_label*.tif) is in the data folder.

Try to achieve a score of IoU > 79%. Include a pdf report that summarizes and ***explains*** your solution. Discuss and plot results similar to Fig. 1 in your report. Provide the predicted refined segmentation image in the same format as the target image (*img_mosaic_pred*.tif). The five submissions with highest IoU and a clear explanation of the solution can get 5 extra points.

Notes. Please exclude the data folder from your submission due to its size. For grading, in addition to evaluating the report and code correctness, we also value the cleanliness and organization of the code. Most importantly, write your ***own*** code.

Questions. If you have questions or find any ambiguities/mistakes, please contact: M. H. Shams Eddin (shams@iai.uni-bonn.de) or Sassan Mokhtar (mokhtar@iai.uni-bonn.de).

Important: You are not allowed to use any additional python packages beyond the ones imported in the template.

Grading: You must submit a code that runs and produces reasonable results.

Plagiarism: Do not cheat and copy the solution from anywhere. We need to verify that the code is yours and that you fully understand it.

Any violation of these rules will result in receiving zero points.

Submission: You can complete the exercise in a group of two, but only one submission per group is allowed. Include a *README.txt* file with your group members in each solution. Points for solutions without a README file will only be given to the uploader.