Advanced Computer Vision

Exercise Sheet 8

Winter Term 2023
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Hand in until: 17.01.2024
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Task 1 – Implement U-Net Model in Python [50 points]

In this exercise, we look at theCWFID segmentation data set from the domain of agricultural robotics [1], where the goal is to segment images of plants growing in a field into bare soil, crop plants, and weeds. In the notebook *segmentation.ipynb*, you find code to load this data set (given in *segmentation_data.npz*) and to visualize the input images and class annotations.

Design a U-Net model for solving this segmentation problem. Your U-Net should follow the general architecture outlined in the lecture. Specifically, we recommend a model that starts at the input resolution of 224×224 and reduces this resolution to 14×14 with a stack of convolution layers, alternating between stride 1 and stride 2 to reduce the spatial resolution in every second layer. In the upsampling part, we recommend to alternate between one convolution and one transposed convolution layer. Do not forget to include the shortcut connections that connect layers in the downsampling part of the model with layers in the upsampling part that have the same spatial resolution. For simplicity, we recommend to use padding such that the resolution is preserved in the convolution layers. The file *unet.png* shows a graph representation of this kind of architecture.

Write a custom loss function for your model that implements the segmentation loss, that is, the categorical crossentropy summed (or averaged) over all spatial positions in the image. Train the model on the provided training data (recommended 500 epochs) and evaluate its accuracy on the test data. For all training examples, visualize your predictions and the corresponding ground truth nnotations as images.

[1] S. Haug and J. Ostermann. A Crop/Weed Field Image Dataset for the Evaluation of Computer Vision Based Precision Agriculture Tasks, 2015, Computer Vision - ECCV 2014 Workshops.