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Semantic segmentation of aerial images under consideration of training samples with noisy class labels

Proposal for a Master thesis topic (DE/EN)

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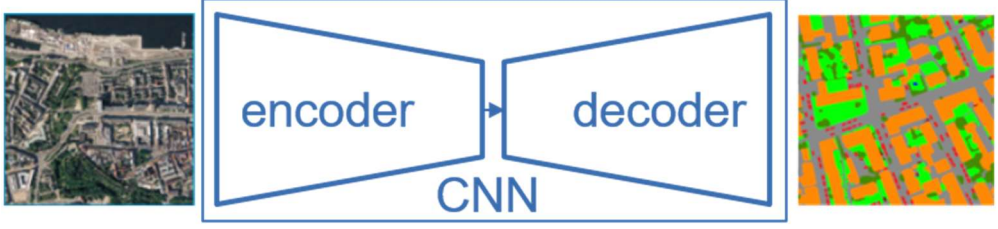
Pixel-wise classification of land use based on remote sensing images is of interest in the context of several applications, e.g. for determining the development of cities or open spaces and for planning future land use. Training such a classifier requires images with known reference labels for all land use classes to be differentiated. To guarantee a high quality of the training labels, such a reference is usually created by a human operator, being time-consuming and thus, expensive. To overcome this shortcoming of requiring manually created training labels, other land use information, e.g. stemming from topographic information systems, can be adopted for training. As such systems are often not as frequently updated as the land cover might changes, the contained information might be partly wrong. Thus, techniques dealing with partly wrong labels (label noise) have to be used for training the classifier.

In the context of a master thesis, a strategy for training a deep neural network that allows for noisy labels has to be developed. The neural network should perform semantic segmentation (see Figure 1), where relevant features are extracted from an input image by an encoder and afterwards, pixel-wise predictions are provided by a decoder that upsamples the features to the original image resolution. The encoder can either rely on convolutions or optionally on attention mechanisms. Key of the thesis is the training strategy that should allow to learn the network weights such that the classifier makes correct predictions, even though parts of the training labels are incorrect. Such a training strategy could rely on existing approaches for learning from noisy labels, e.g. in (Song et al., 2022).

The master student can start from an existing implementation of a neural network for semantic segmentation and will be provided with a dataset, consisting of aerial images, a manually generated reference for land cover as well as a potentially error prone land cover reference derived from a topographic information system.

Song, H., Kim, M., Park, D., Shin, Y., & Lee, J. G. (2022). Learning from noisy labels with deep neural networks: A survey. IEEE Transactions on Neural Networks and Learning Systems.

Figure 1: Basic principle of semantic segmentation. An input image is provided to a convolutional neural network (CNN) consisting of an encoder and a decoder. The output of the CNN is a label map containing one prediction per pixel.



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