Weakly Supervised Region Segmentation

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1- Introduction

Image segmentation involves converting an image into a collection of regions of pixels that are represented by a mask or a labeled image. By dividing an image into segments, we can process only the important segments of the image instead of processing the entire image.

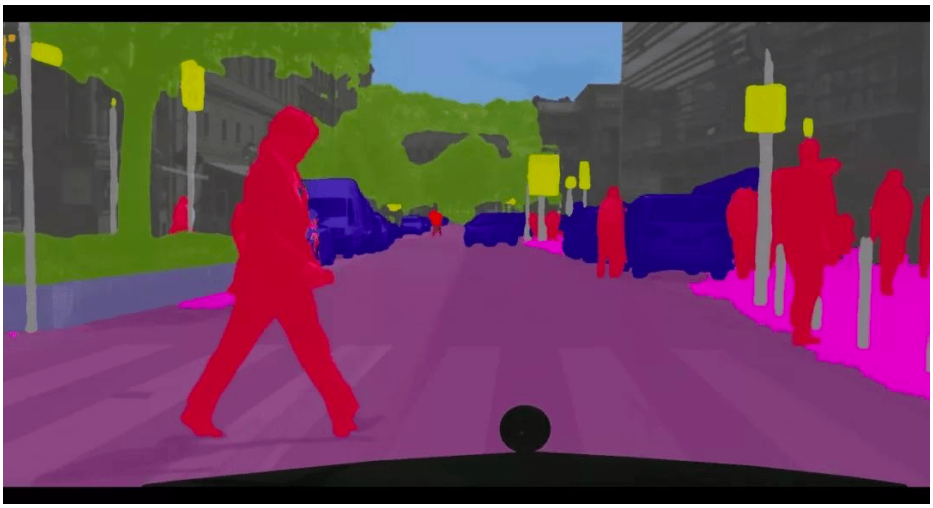

Figure 1: Schematic representation of the image segmentation problem. For every pixel of one input image, the system must produce one output (label) that corresponds to the type of object at that location.

The state-of-the-art neural networks for image segmentation, based in deep learning frameworks (e.g., U-Net []) are able to attain remarkable results in this task. However, they demand the availability of a very large set of images manually segmented, like the illustrated in Fig.1. As expected, producing this type of annotation is very time consuming and requires a substantial amount of human effort, which is seen as an obstacle.

The main goal of this project is to develop a novel solution for weakly supervised region segmentation, i.e., develop a segmentation model based in deep learning that does not require learning data annotated at the pixel level, but instead annotated at the image level:

Person, 1

Tree, 1

Road, 1

Sky, 1

Building, 1

Vehicle, 1

Figure 2: Example of one possible weakly annotation file corresponding to the data illustrated in Fig. 1.

Comparing the number of annotated labels in Figs. 1 and 2, it is evident that weakly annotated labels might represent a decrease of over 99% in the number of labels required for learning, which will speed-up the creation of novel segmentation models.

2- Keywords

Image segmentation; weakly supervised learning; multiple instance learning

3- Objectives

The proposed work comprises the following consecutive goals:

a) Development of a novel loss formulation for weakly supervised region segmentation;

b) Capturing and annotation of a dataset for weakly vs. strong supervised segmentation comparison;

c) Performance evaluation, debugging and optimization of the proposed approach;

d) Writing of a publication describing the work carried out, to be submitted to an international conference/journal.

4- Tasks

The following work plan is designed:

T1: Study of the existing techniques for semantic segmentation.

T2: Analysis of the loss functions used for semantic segmentation.

T3: Development of a novel loss formulation for wekly supervised semantic segmentation.

T4: Performance evaluation of the developed approach.

T5: Report writing.

References

[1] U-Net: Convolutional Networks for Biomedical Image Segmentation. Olaf Ronneberger, Philipp Fischer, Thomas Brox. Medical Image Computing and Computer-Assisted Intervention (MICCAI), Springer, LNCS, Vol.9351: 234--241, 2015, available at arXiv:1505.04597 [cs.CV]