KI DELTA LEARNING
Scalable AI for Automated Driving

Consistency-based Active Learning for Semantic Segmentation

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Consistency-based Active Learning

For the Cityscapes dataset, more than 1.5 hours was required to label a single image for semantic segmentation [1]. We investigated two complementary means to reduce the associated annotation costs:

1. Consistency-based active learning (AL)
2. Superpixel-based instead of image-based annotation

Note that annotation of a superpixel's dominant class can be achieved with a single keystroke.

Approach

For consistency-based AL we compared the segmentation results of flipped and original image and rank by the number of mismatched pixels (matching score, see also Fig 1).

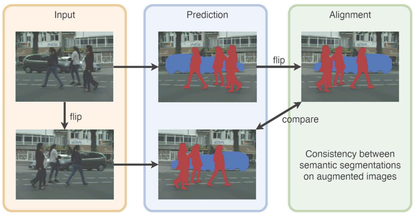

Figure 1: Our consistency-based AL approach (© fortiss | BMW)

We apply this matching score to whole image segmentations and superpixel level annotations.

Experiments and Results

For superpixel-based AL we compare our work to a reimplementation of [2]. For image-based AL we compare our acquisition function to the acquisition function proposed in [3]. All experiments were conducted on the Cityscapes dataset and use the mIoU metric.

We followed the evaluation protocol of [2] for the superpixel-based approach. For image-based AL, we first randomly select 10% of images to train the initial model. The same amount is queried per round according to the respective acquisition function for labeling. Results are summarized in Fig. 2.

Conclusion

Our method performs equally well or better than the investigated AL approaches in both acquisition regimes, yet is simple to implement. The performance improvement of [2] is largely attributed to the class balance correction, which can be used in our approach in future work.

Also note the higher efficiency of superpixel-based AL compared to image-based AL. Since the labeled regions are more evenly distributed across the dataset, these models benefit from a greater diversity. In future work it would be interesting to investigate the limits of the superpixel-based active learning.

References:

[1] M. Cordts et al. "The Cityscapes Dataset for Semantic Urban Scene Understanding". In: Proc. of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR). 2016.
[2] L. Cai et al. "Revisiting superpixels for active learning in semantic segmentation with realistic annotation costs". In: Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2021
[3] S. A. Golestaneh and K. M. Kitani. "Importance of self-consistency in active learning for semantic segmentation". In: arXiv preprint arXiv:2008.01860 (2020).

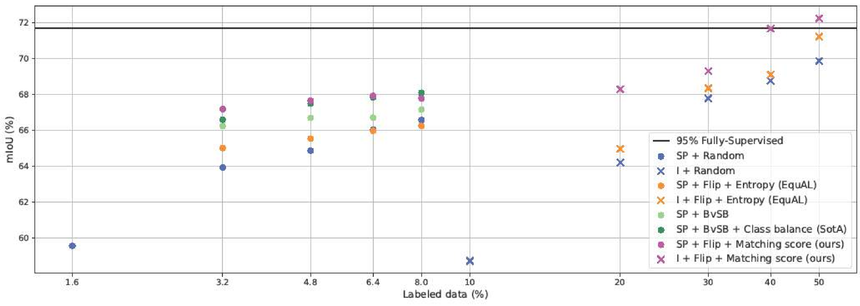

Figure 2: Comparison of consistency- and uncertainty-based AL approaches on Cityscapes for image- (I) and region-based (SP=superpixel) semantic segmentation (© fortiss | BMW)

Active Learning

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