Institut für Computertechnik
Institute of Computer Technology

Christian Doppler Forschungsgesellschaft

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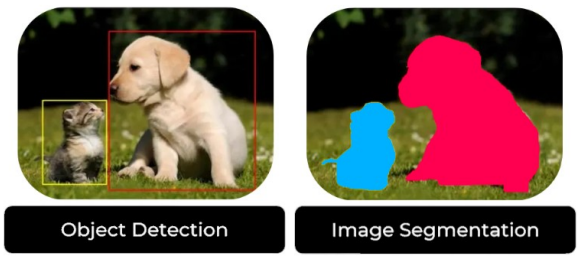
MEMBER OF THE FREQUENTIS GROUP

Master Thesis: Simultaneous Detection and Segmentation of Different Objects

The Embedded Machine Learning (EML) team is part of the Christian Doppler Laboratory and does research on Deep Neural Networks (DNNs) in resource-constrained embedded devices. It studies how energy consumption and resource usage can be minimized while keeping high accuracy. The solution space is characterized by architecture parameters, DNN optimization and transformations, implementation platform configurations, and mapping options. This design space is huge, poorly understood, and rapidly evolving.



A Convolutional Neural Network (CNN) for object detection generally consists of two parts: (1) a feature extractor, also called an encoder, compressing the original image and providing a low dimensional representation of the original image. (2) A classifier (a fully connected layer) and a localizer (a bounding box regressor), providing the object class and the location of the object, respectively. In contrast, a CNN for segmentation generally consists of an encoder, as stated above, followed by a decoder, which converts back the compressed representation into pixel-level classification. Bounding box detection is quite accurate for objects having square/rectangular shapes (e.g., traffic signals) but not acceptable for curvy shapes (e.g., road lanes). If it is required to detect objects of different shapes simultaneously, then one CNN is typically used for object detection and another for segmentation using the same images/frames, which almost double the computational load on an embedded platform.
This thesis project aims to use a single encoder for both object detection and segmentation, as it is common in both CNNs and evaluate the corresponding accuracy degradation if it happens. This thesis project consists of the following steps:

- Select one of state-of-the-art CNN, e.g. MobileNet
- Train/test it for object detection using a few classes
- Freeze the encoder and use it for the segmentation
- Train (only decoder)/test it for segmentation
- Finetune/train/test the segmentation architecture
- Simultaneous train/test both networks

This thesis offers you an excellent opportunity to get into the hot topic of deep learning. It allows you to become an expert in configuring neural networks. Moreover, you acquire critical skills in using neural networks in embedded systems and resource constraints. Some of the M.Sc. projects may be combined with a part-time position. For details, please consult the following:

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