Embedded Semantic Segmentation

- The goal of semantic segmentation is to achieve pixelwise classification of an image into different object classes/categories of interest.
- A value from the label space L = $\{l_1, l_1, ..., l_k\}$ is required to be mapped to the pixel space P = $\{p_1, p_1, ..., p_{WxH}\}$, where W and H are the width and height of the image.
- The different deep learning architectures used for Semantic Segmentation are:
  - Fully Convolutional Network: The last fully connected layer of a convolutional neural network is replaced with a convolutional layer in order to obtain a semantic map as a result.
  - Encoder-Decoder architectures:
  - Dilated convolutions:
- The restriction of an embedded environment makes the usage of deep learning challenging. This restriction affects the number of free parameters the network can have. For instance, the FCN network based on VGG-net, pretrained weights trained on the PASCAL VOC dataset is large (514 MB and has 134M parameters.)[1],[2].
- The second restriction of achieving less than 1 sec to obtain a semantic map of an image (during inference) could benefit from reduced number of free parameters in a lean model.
- A lean model could also pose a restriction on the expressiveness of learned representations. In turn this could restrict the number of object classes.
- The following could be the list of tasks:
  - Understanding and implementing convolutional neural networks.
  - Reviewing literature on deep learning methods used for semantic segmentation.
  - Reviewing literature on approaches to deploy deep networks in an embedded environment.
  - Reviewing traditional approaches to semantic segmentation (the possibilty of adapting such techniques in a deep learning setting).
  - Implementing and comparing the best few approaches based on accuracy, runtime during inference, model size, RAM required during runtime.

- Further reasearch on instance segmentation (which requires both object detection and semantic segmentation).

References

[1] J. Long, E. Shelhamer, and T. Darrell, âĂIJFully convolutional networks for semantic segmentation,âĂİ in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2015, pp. 3431âĂŞ3440. Weblink

[2] Weblink

[3] A. Garcia-Garcia, S. Orts-Escolano, S.O. Oprea, V. Villena-Martinez, and J. Garcia-Rodriguez, âĂIJA Review on Deep Learning Techniques Applied to Semantic SegmentationâĂİ in arXiv. Weblink