Leids Universitair Medisch Centrum

Master Thesis project
In Biomedical Machine Learning

Interactive Segmentation using Uncertainty from Bayesian Deep Learning for Head and Neck Radiotherapy

Project overview

Deep learning has made great strides in the field of medical image segmentation and is now poised for usage in clinical practice. However, the model's outputs are not always clinically acceptable and hence need to be reviewed and edited. Currently, this quality analysis (QA) is manual in nature and could benefit from semi-automated techniques driven by user inputs: i.e. interactive segmentation. Recently, it has been shown that uncertainty extracted from Bayesian neural networks (BNN) corresponds to potentially erroneous predictions. Thus, this uncertainty can potentially provide visual cues to users to rectify erroneous segmentations.

The **goal** of this MSc thesis is to investigate the usage of uncertainty of existing BNNs such as Dropout and FlipOut by designing feedback methodologies (e.g. foreground & background scribbles[1]) and corresponding neural architectures to rectify model inaccuracies. The designed feedback method would then be converted to a 3D Slicer module. The application domain will be that of auto-segmentation of organs-at-risk in head and neck CT data for radiotherapy purposes. Annotated data, compute hardware and software and baseline (CNN) networks are readily available.

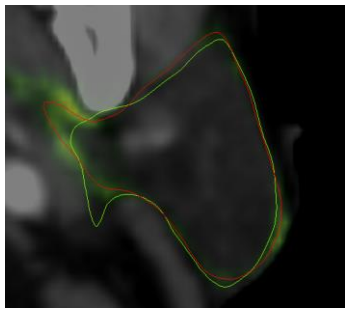

Figure 1: CT Scan with prediction (red), ground truth (green) and an overlaid uncertainty heatmap for the parotid gland.

[1] Wang, Guotai, et al. "Interactive medical image segmentation using deep learning with image-specific fine tuning.", https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8270673

Where and when?

The project will take place at the Division of Image Processing, Department of Radiology, LUMC, https://lkeb.lumc.nl/. You will be supervised by dr. Marius Staring and Prerak Mody, MSc. Start date of the project is flexible, duration is 8 – 12 months.

Who?

Students with a major in computer science, mathematics, biomedical engineering, artificial intelligence, physics, or a related area in the final stage of master level studies are invited to apply. Affinity with Python programming is required, as well as interest and experience with machine learning and deep learning.

Interested?
Contact: dr. Marius Staring (**m.staring@lumc.nl**)