Abdominal multi-organ segmentation using deep neural networks (CT)

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Motivation

Medical image segmentation is an incredibly useful diagnostic method for medical practitioners to speed up patient diagnoses and treatment. Typically, medical image segmentation must be done by a highly-educated and trained professional to guarantee the accuracy of segmentations. However, completing a segmentation can take a lot of work. As such, automating the segmentation of scans, to as great an extent as possible, would decrease the time taken for patient diagnosis and treatment. Due to these scans' complexity, this task is perfect for novel neural networks.

Aims

This project aims to describe and create a novel machine-learning approach to 3D abdominal medical image segmentation. To gauge the success of the project, the accuracy of the scans will be quantified by the Dice coefficient between unseen scans and their correct labels. Also, the efficiency of the model will be considered throughout and improvements to the efficiency without affecting accuracy will be sought throughout. Additionally, the Dice coefficient and the proposed network's efficiency will be compared to other networks and techniques used in the literature. Further, if possible, I would like to aim to combine techniques from literature to benefit from both of them - specifically UNet architecture's effectiveness and the Perceiver IO model's efficiency.

Progress

So far, a neural network architecture has been selected (Perceiver IO) and applying the network to the open MICCAI AMOS 2022 dataset is underway. Correct and effective preprocessing of the dataset has been done, including effective image coregistration. Most recently, tweaks to the model have been made in order to try and get good-quality results out of the network after training.

Problems and risks

Problems

Due to the complexity of the network and the size of the scans, training is either not possible or is slow, due to my own hardware's capabilities/capacity limiting the network, input image size, and preventing techniques like batching from being applied.

Risks

The training times required may mean that a model cannot be trained effectively within the given time span. **Mitigation:** Try to use pre-trained weights as a starting point (although seems unlikely) or gain access to the compute cluster as hardware is better.

Despite training times, the model may not be more effective than the current networks in the literature. **No mitigation available**

Plan

Semester 2:

- Week 1 (beginning January 9th) Refine the model based on what was learned through experimentation and analysis
- Week 2 Compute evaluation metrics (Dice Coefficient, Haussdorf Distance, time for inference (ms))
- Week 3 Refine the model further
- Week 4 Retrain and submit results for validation stage to AMOS 2022 site
- Week 5 Dockerise model
- Week 6 Finish dockeristaion and submit for validation stage
- Week 7 Further refine and resubmit if necessary
- Week 8 Write Draft Essay
- Week 9 Write Draft Essay
- Week 10 [TERM ENDS] Complete Draft essay
- Week 11 Dissertation submission deadline and presentations.