OncoScan AI: Advanced Imaging for Stomach and Intestine Cancer

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Motivation

In 2019, an estimated 5 million people were diagnosed with gastrointestinal tract cancer worldwide. Half of these patients are eligible for radiation therapy, a treatment that can be time-consuming due to manual segmentation of stomach and intestines in MRI scans. Our motivation is to leverage data science and deep learning to automate this process, making treatments faster and more effective. The aim is to separate stomach and intestine from the tumor using Image Segmentation along three classes namely stomach, large bowel, small bowel.

Methodology

Low-Risk Problem

In the low-risk phase, our focus is on preparing the ETL pipeline and assessing the image segmentation task using a pretrained convolutional neural network (CNN). We aim to achieve efficient data extraction, transformation, and loading processes, while evaluating the segmentation performance based on the Mean Dice coefficient. The completion date for this phase is set for 5th February.

Medium-Risk Problem

In addressing the challenge of fine-tuning and evaluating the performance of other state-of-the-art architectures, including Inception V3, VGG19, DenseNet121, and EfficientNet B0, our method involves implementing a temporal convolutional network (TCN) to accommodate day-to-day changes in the data.

The evaluation will be based on mean Dice coefficient and 3D Hausdorff distance, with a targeted completion date of 11th Feb. This comprehensive study aims to provide insights into the strengths and weaknesses of these architectures.

High-Risk Problem

Addressing the segmentation challenge involves implementing a custom U-Net model and benchmarking it against state-of-the-art architectures. To tackle the issue of insufficiently annotated data, our approach incorporates semi-supervised learning techniques. Evaluation metrics include the Mean Dice coefficient and 3D Hausdorff distance. The completion date for this methodology is set for 20th February, ensuring a timely and comprehensive analysis of the proposed solutions.

Impact

Successful implementation of our solution will significantly reduce the time and labor required for manual segmentation, enabling radiation oncologists to administer higher doses to tumors while sparing the stomach and intestines. This, in turn, will improve the efficacy of cancer treatment, leading to faster daily sessions and enhanced long-term cancer control.

References:

[1]https://www.kaggle.com/competitions/uw-madison-gi-tract-image-segmentation

[2]https://pyimagesearch.com/2021/11/08/u-net-training-image-segmentation-models-in-pytorch/

[3]https://www.mdpi.com/2306-5354/10/1/119

[4]http://cs231n.stanford.edu/reports/2022/pdfs/164.pdf

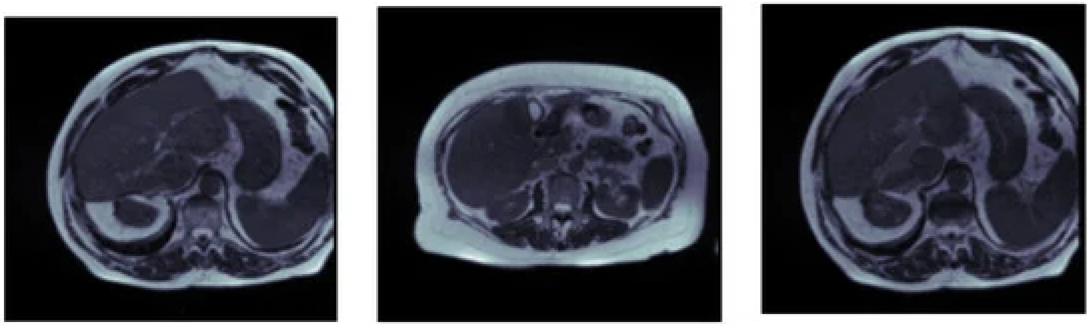

Fig.1: Sample Images in the Dataset

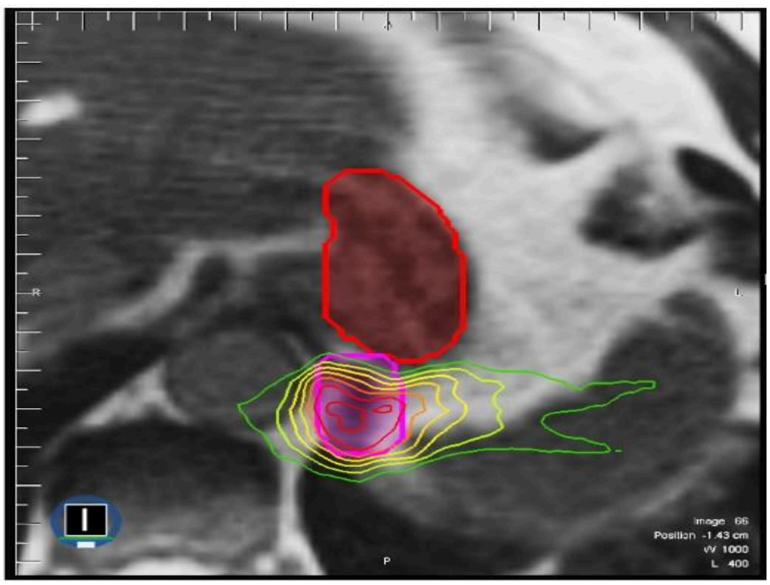

Fig.2: Tumor (pink thick line) is close to the stomach (red thick line). High doses of radiation are directed to the tumor while avoiding the stomach. The dose levels are represented by the rainbow of outlines, with higher doses represented by red and lower doses represented by green.

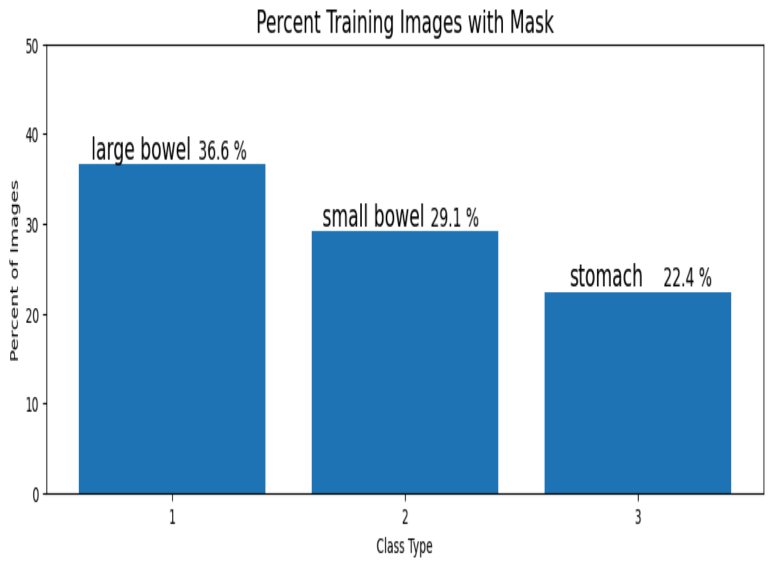

Fig.3: Image contains data distribution among the three classes: stomach, large bowel, and small bowel