Imperial College London

Tackling Crohn's Disease using Deep Learning

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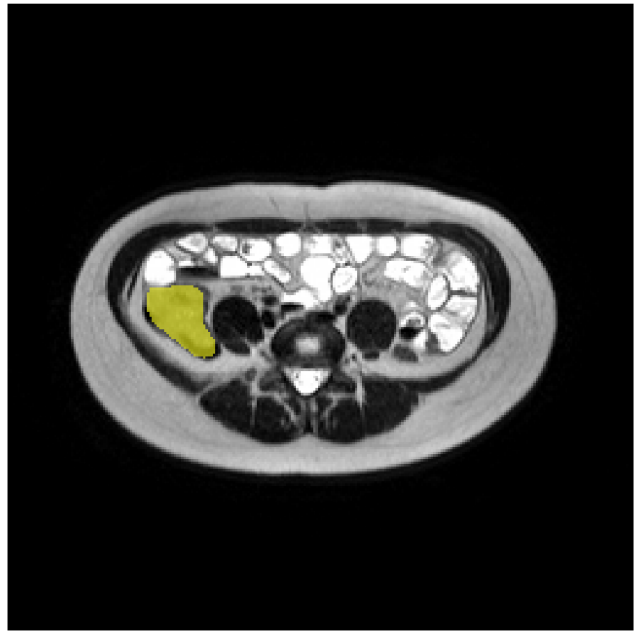
Outline

Overview of this Project



Crohn's Disease

- Crohn's disease is a chronic, incurable type of Inflammatory Bowel Disease (IBD).
- It affects over half a million individuals in the UK and can cause serious complications.
- Symptoms of Crohn's disease are diverse and can include abdominal pain, diarrhea, fatigue, and weight loss.

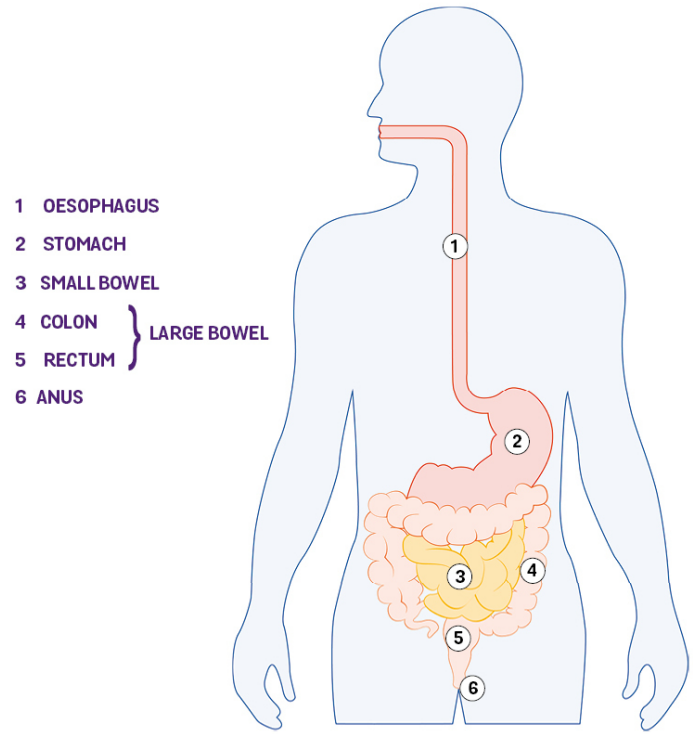


Figure: The gastrointestinal tract of a Human

Terminal Ileum

- Examination of the terminal ileum can significantly improve patient outcomes.
- Related work found a strong correlation between the performance of the automated detection of Crohn's disease and the degree of localisation in the training data.

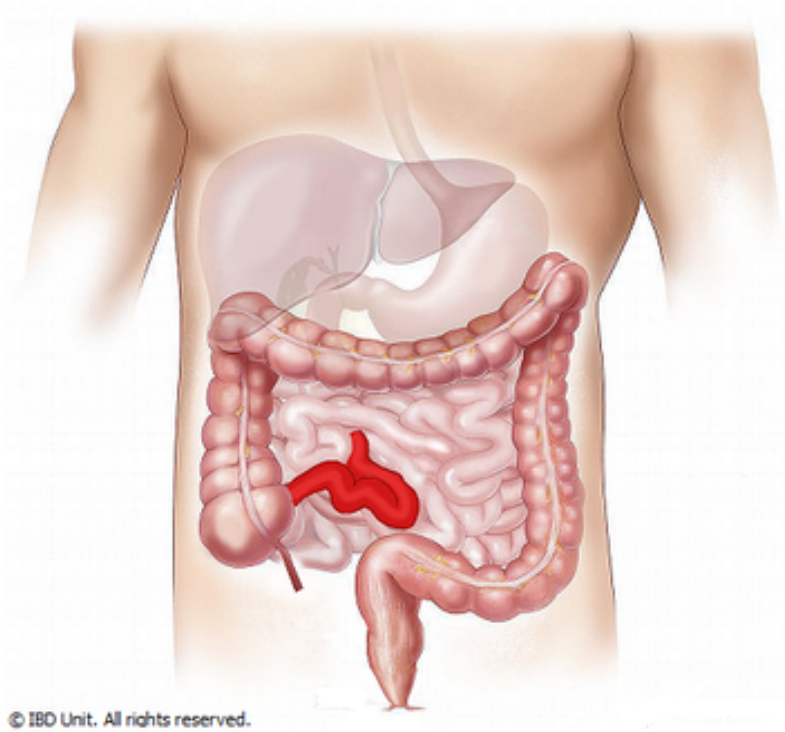


Figure: Terminal Ileum

T2-weighted MR Images

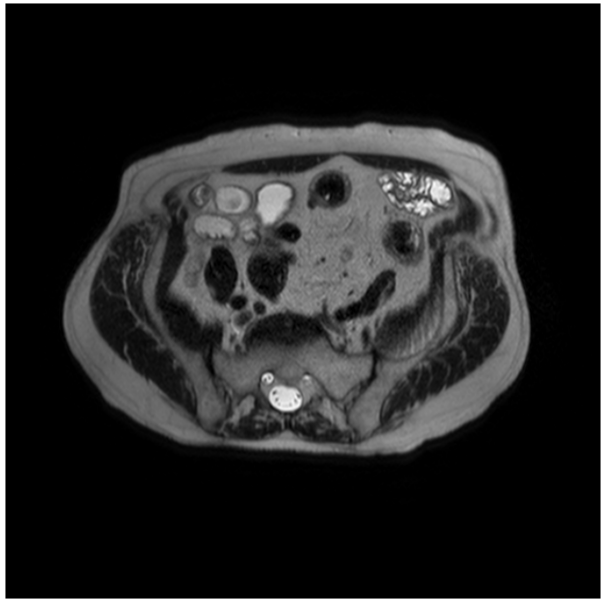


Figure: Axial T2 MR Image

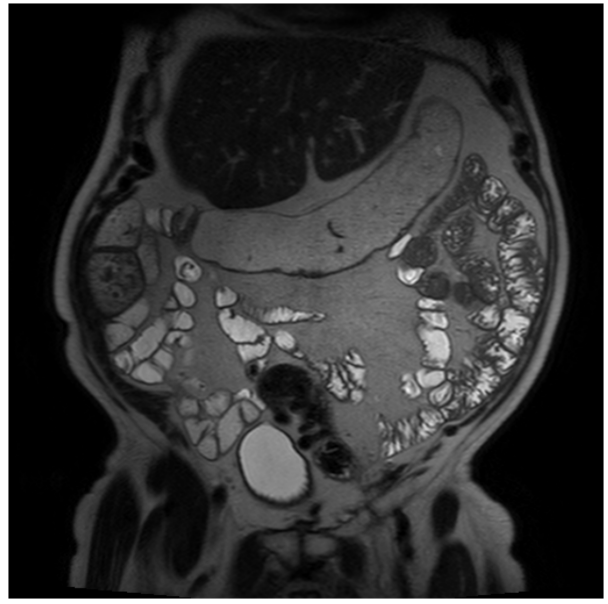


Figure: Coronal T2 MR Image

Machine Learning Challenges

Limited Dataset

We had only 233 cases for both modalities (Axial and Coronal T2 images) collected by St Mark's Hospital. Data scarcity limits the potential to train a high-performing and generalized model.

Lack of Gold-Standard Labels

We had only less than 40 gold-standard segmentations for each modality. Generating gold-standard segmentation is often time-consuming and requires expert knowledge which further adds to this challenge.

Utilisation of Unlabelled Data

Another challenge lies in finding an effective way to utilise the unlabelled data in the training process, which also contributes to creating a more comprehensive and robust model.

Overview of the Methodology

Our methodology involves a two-phased training algorithm to effectively utilise the available data and maintain segmentation precision.

- **Proxy Model Training:** The initial phase involves generating "weak labels" for the unannotated data using a fine-tuned MedSAM model. A proxy model is then trained on these weak labels using the nnU-Net architecture.
- **Target Model Training:** The second phase leverages the proxy model, further training it on 80% of fully annotated data to generate the final target model.

This approach aims to maximise data utilisation and maintain high precision in the terminal ileum segmentation. The effectiveness of the model is assessed by the Dice similarity coefficient on the remaining 20% of the fully annotated data.

Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table: Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)

Title of the publication

Journal Name 12(3), 45 – 678.

Thank you for your attention