Areas of Focus End Goal: Un-/Supervised image segmentation of GI tract	
Supervised Learning	Developing a model that can segment GI tract labeled data (at the multi class level) - Or potentially trying semi supervised methods before transitioning to unsupervised
Unsupervised Learning	Developing a model that can segment unlabeled GI data (at the multi class level)
Systematic/Automated Models	Finding and Implementing models that can a) Handle data dumps and auto filter b) Use 3D data to help systematic work on 3D data e.g. easy changing of planes, or depth
Segmentation Models for Motility Data	Building an algorithm tailored to motility data, not fMRI or strictly structural MRI
Synthetic Data Generation	- Algorithm to generate synthetic Madison data - Algorithm to generate synthetic human motility data either labeled/unlabeled - e.g. GAN/generative modelling/ model-based modelling

Datasets End Goal: algorithms work with a human motility dataset	
Brain Tumor Set	https://figshare.com/articles/dataset/brain_tumor_dataset/1512427/5
GI Tract Set (Madison)	https://www.kaggle.com/competitions/uw-madison-gi-tract-image-segmentation/data

Literature

End Goal: A focused literature review

Step 1: Build a comprehensive Zotero library - with appropriate tags e.g. low contrast, motility data, unsupervised, etc.
Step 2: Create and fill in an Excel table with: [models the paper used, type of data they used (static, dynamic?), whether it was human or animals, and data size]
Step 3: Create figures based on the trends from the table to visualize the SOA and inform background context
Step 4: Building an outline for the literature review
Step 5: Final writing and assembly
Questions
1. What work has been done on image segmentation using 3D data? (specifically in GI data is best) 2. What are the current methods and models used for GI tract segmentation? 3. What methods are being used specifically for motility data? 4. Is UNET the best model for the GI tract segmentation or not? 5. What datasets have been used in GI tract segmentation research – labeled, semi-labeled or unlabeled? 6. What research has been done on data that is low contrast? 7. What research has been done on data that has low sample size? 8. What preprocessing methods exist for GI segmentation models? 9. What is considered “small” data or “sufficient” data when training image segmentation models? 10. Where is the threshold for “quality” MRI, where do we draw the line?

We Are Here

A UNET Model that Segments 3 Classes of Human Brain Tumor Structural MR Images

Where We Need to Be

A Model that Segments 3 Classes of Human GI Motility MR Images

Road Map & Routes

A) UNET/CNN path
- How well can the model segment labeled brain tumor data?

    - Polish the UNET so it works great on the labeled brain tumor dataset
    - How well does the model perform depending on the plane and the tumor type?
- How well can the model segment labeled GI data?
    - Configure the UNET model to work on labeled Madison GI tract dataset
    - Continue with UNET or select new method – refer literature
- How well can the model segment semi-labeled data?
    - Strip the Madison data down to a few labels
    - Continue with UNET or select new method – refer literature
- How well can the model segment unlabeled data?
    - Remove all labels and alter/replace the model
    - Continue with UNET or select new method – refer literature
- How does performance change depending on the number of classes the model segments? E.g. 1, 2 or 3 regions of interest

B) Synthetic Data Generation

- How can we generate synthetic MRI GI data from the Madison set? Is it any good?
    - Look into generative or model-based approaches
    - Refer to literature
- How can we make this generator adjustable? e.g. allow a user to “turn the knob” of
    - how much data they want generated
    - the contrast level of the data (more/less contrast MRI)
    - Can we generate different subject data?