Cross-modal MRI image registration

Team

1. Shalini Kothuru - skothuru@iu.edu
2. Sreekar Chigurupati - srchig@iu.edu
3. Venkata Sai Abhigna Devarasetty - vdevaras@iu.edu

Problem

The problem we will be tackling is **Brain MRI image registration**. Image registration is the process of matching one object to the shape of another. It is paramount in medical imaging for comparisons across subjects or tasks like mapping disease progression. We will base our implementation on the UNet-based model - VoxelMorph. VoxelMorph performs registration by learning a deformation field that maps from one image to another. It works on a UNet architecture.

Goals

1. Implementing the main network architecture and loss functions afresh and training with existing data - OASIS
2. Replicating the results with other datasets - HCP Young Adult, ADNI
3. Make it viable for lower-resolution data by reducing UNet downsampling and interpreting results
4. Modifying the loss function to be based on normalized mutual information to work for cross-modal registration

Data

OASIS Brains (N = ~500)
ABIDE (N = ~2000)
HCP Young Adult (N = ~1100)
Alzheimer's Disease Neuroimaging Initiative (N = ~500)

Task distribution

Sreekar - Implementing original VoxelMorph architecture, domain-specific data preprocessing and cleaning. Experimenting with different cross-modal data.
Shalini - Implementing and experimenting with reduction of downsampling in UNet. Training and hyperparameter tuning with HCP
Abhigna - Implementation of new loss function. Training and hyperparameter tuning with ADNI