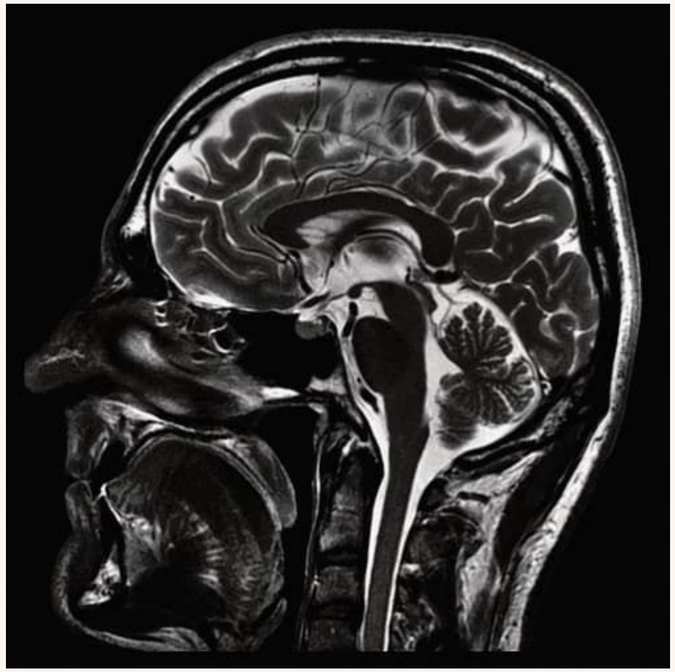
Ischemic Stroke Intervention

Overview

- Introduction
- Medical Background
  - how a stroke happens, different brain tissue, how an mri works
- Research
  - methods, real world examples, results, problems lacking
- What I plan on doing
  - data, preprocessing, methods, segmentation,
- Next step, future work, citations

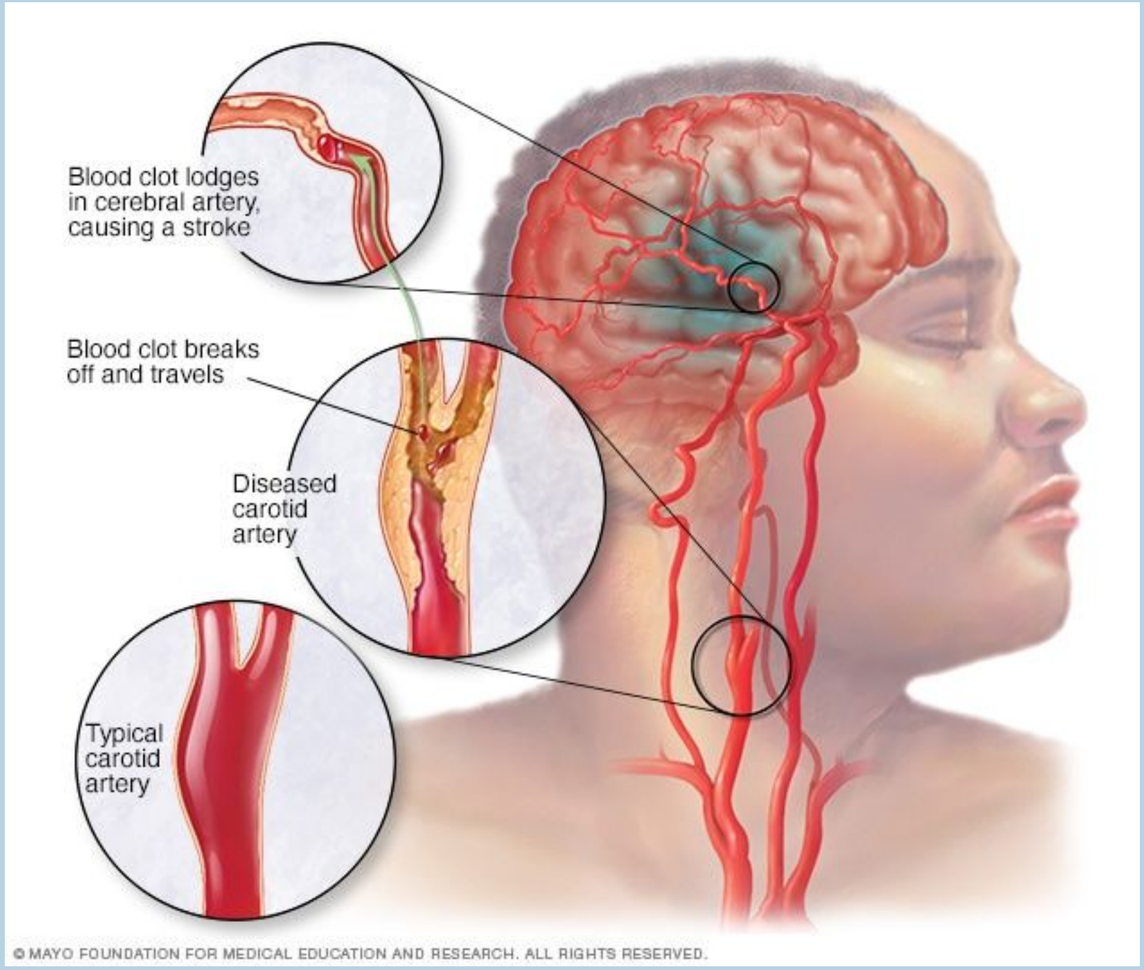
Introduction



This project aims to create a deep learning model that will identify different types of damaged tissue caused by a stroke.

Medical Background

1. HOW AN ISCHEMIC STROKE OCCURS

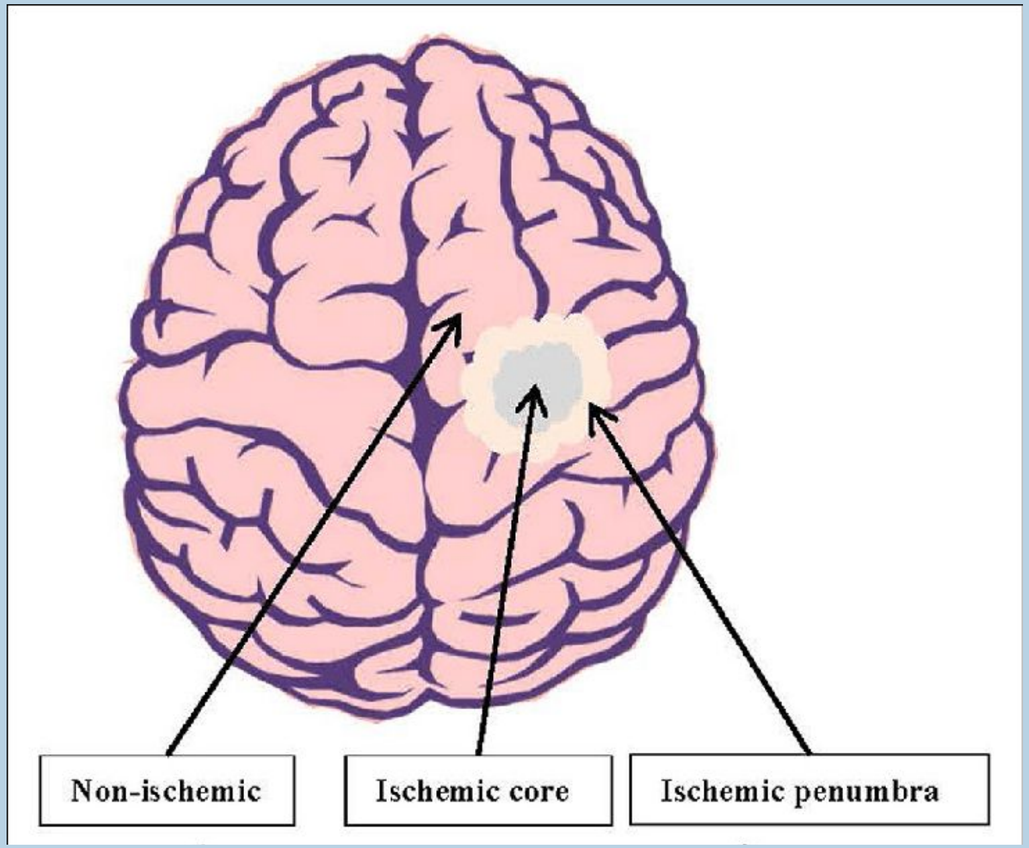


- Blood clot causes loss of oxygen to the brain
  - Narrow arteries form the blood clot
  - Blood clot travels through the body to the brain
- Common symptoms: sudden numbness in the face, arm, or leg, sudden confusion or trouble speaking, etc

Medical Background

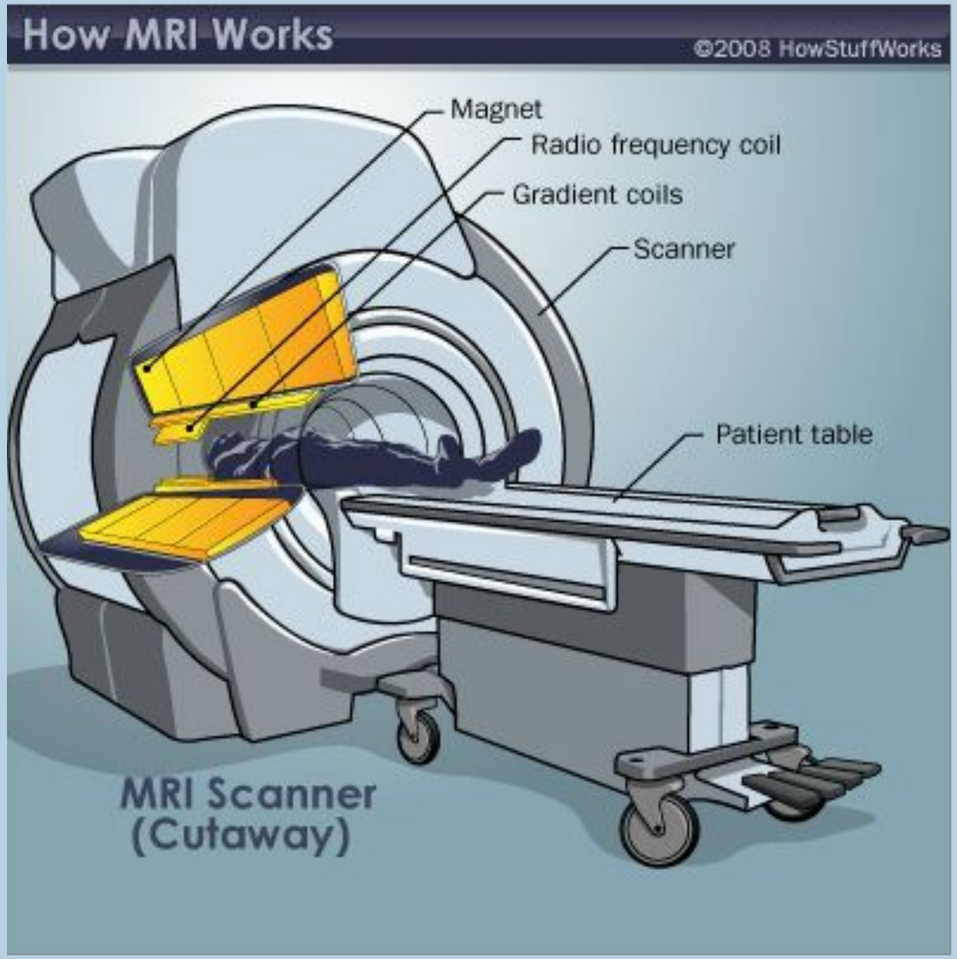
2. ISCHEMIC TISSUE

- Ischemic Core: Central region of the stroke-affected area with severely compromised blood flow.
  - Irreversible damage due to prolonged lack of oxygen and nutrients.
- Penumbra: Surrounds the ischemic core and has partially compromised blood flow.
  - Viable tissue as cells are functionally impaired but still have the potential for recovery.



Medical Background

3. HOW AN MRI WORKS

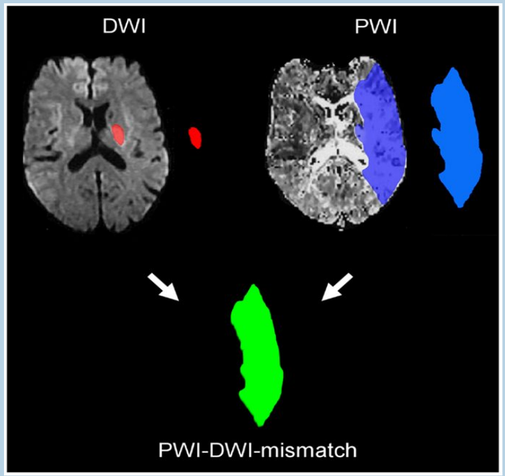


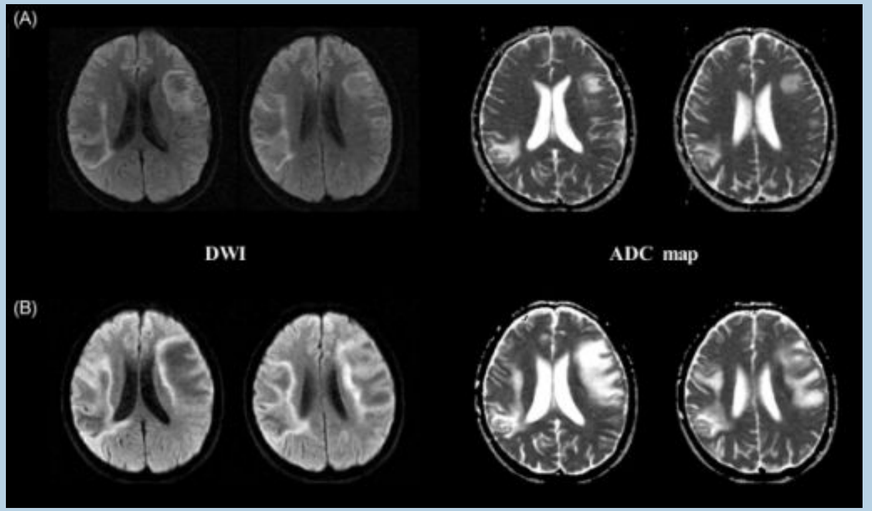
1. Strong magnets align hydrogen atoms in the body.
2. Radio waves are sent, disrupting the alignment.
3. Hydrogen atoms emit signals as they return to alignment.
4. Machine detects emitted signals.
5. Computer processes signals to create detailed body images.

Medical Background

4. TYPES OF MRI

- Diffusion-Weighted Imaging (DWI) captures how water molecules move in tissues, highlighting areas of restricted or free water movement
- Perfusion-Weighted Imaging (PWI) maps blood flow by using a contrast agent, assisting in assessing blood supply
- ADC maps show how water moves in tissues and gives characteristics based on the speed and direction of water diffusion

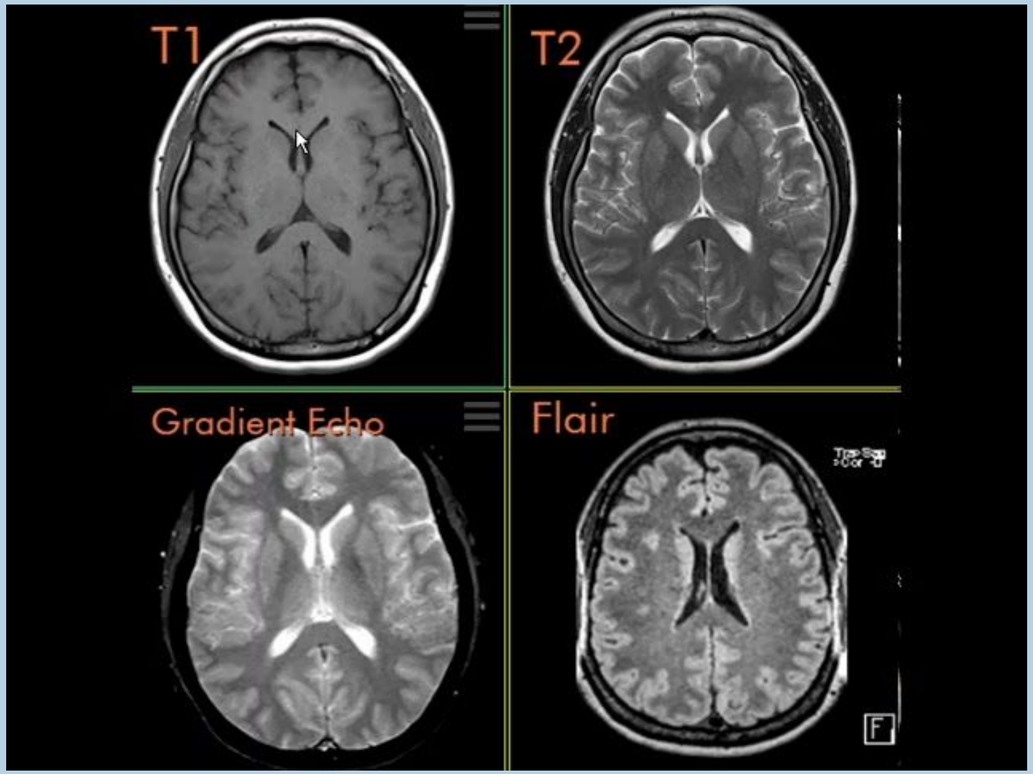




Medical Background

5. TYPES OF MRI

- Fluid-Attenuated Inversion Recovery (FLAIR) suppresses signals from cerebrospinal fluid, enhancing visibility of brain lesions



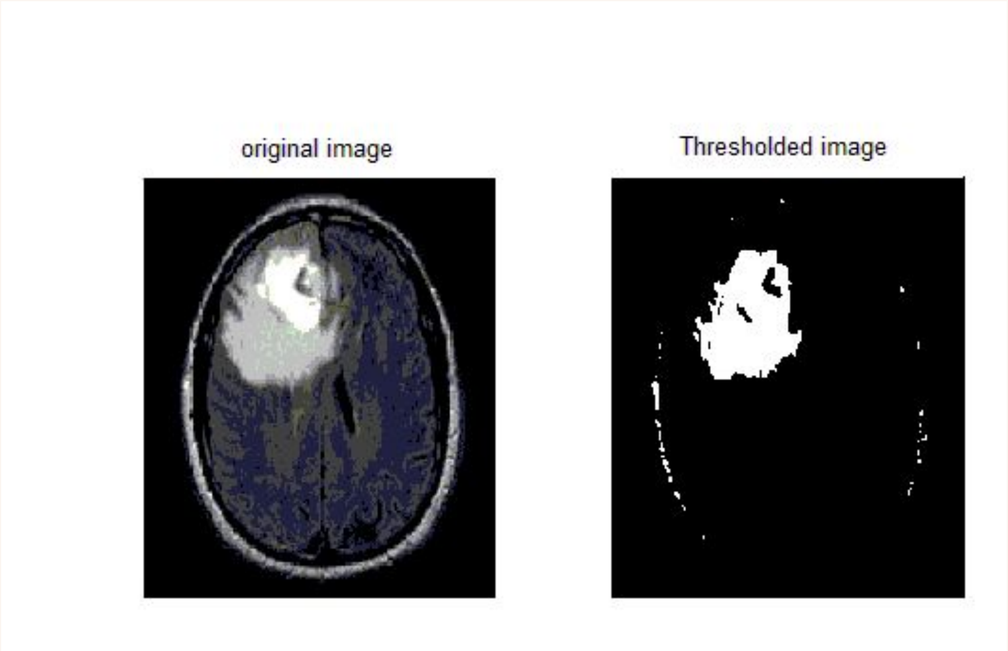
Research

THRESHOLDING

MRI thresholding is a technique used to segment different tissue regions based on intensity values.

Ischemic Core Identification: In ischemic stroke analysis, a low threshold is often applied to DWI sequences to identify the ischemic core—areas with severe signal intensity changes indicative of irreversible damage

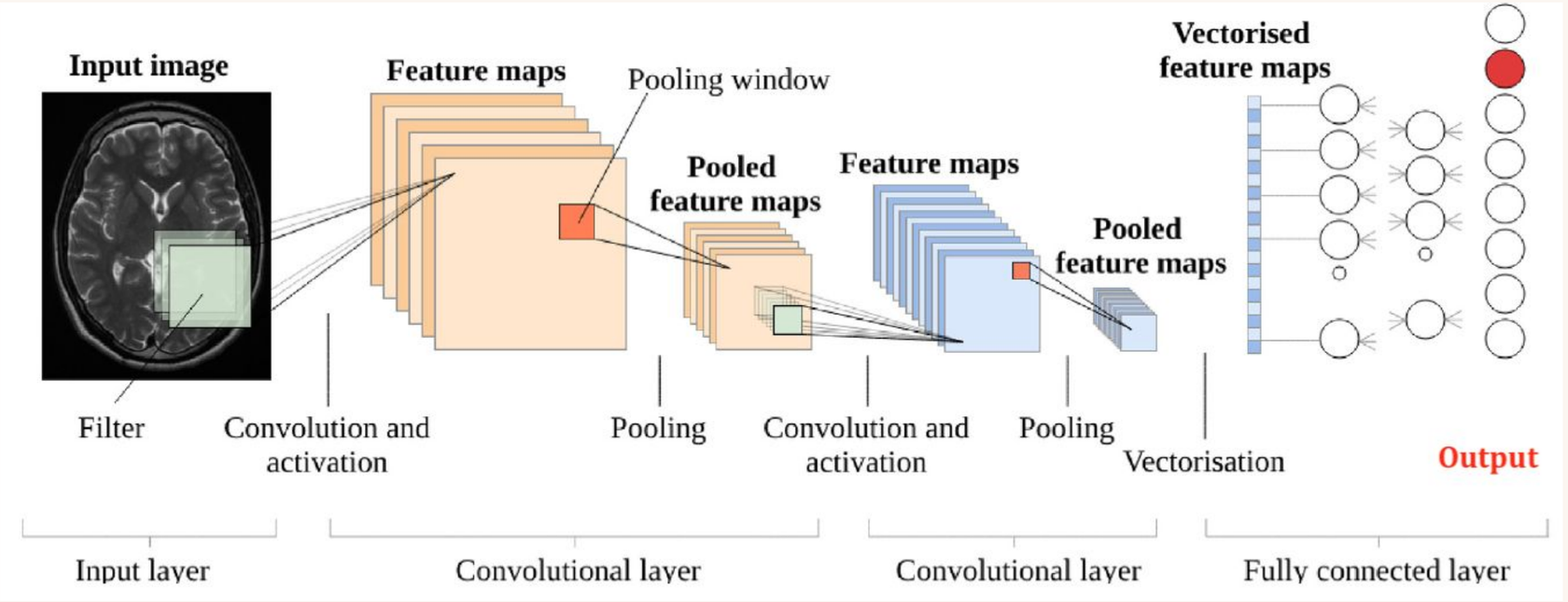
Penumbra Identification: Another threshold, often applied to Perfusion-Weighted Imaging (PWI) sequences, helps identify the penumbra—a region surrounding the core with less severe intensity changes, suggesting potentially salvageable tissue.



Research

AUTOMATIC SEGMENTATION WITH DEEP LEARNING

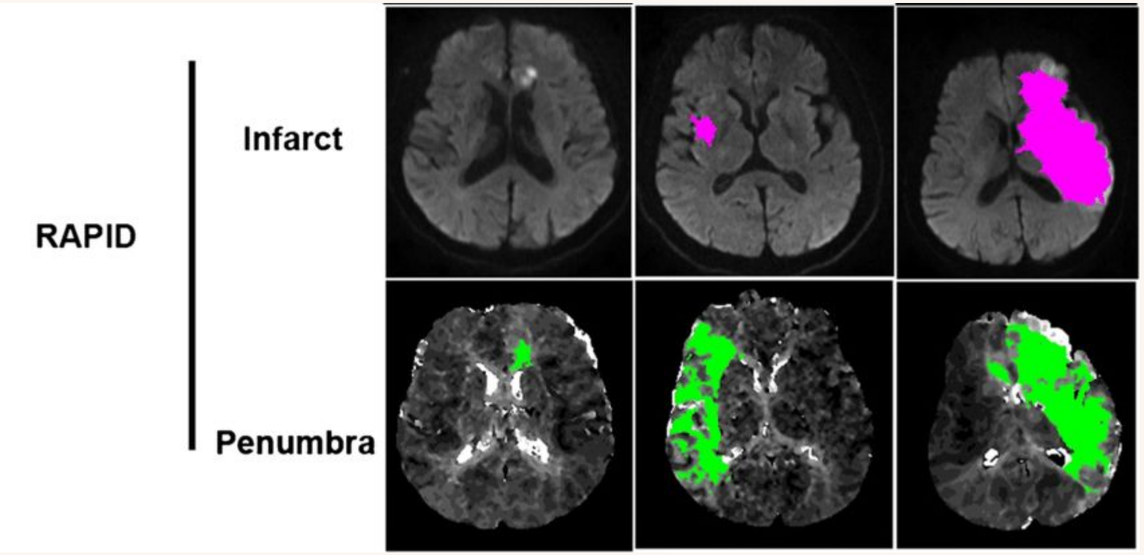
The utilization of deep learning techniques, particularly convolutional neural networks (CNNs) and U-Net-based models has shown great promise in accurately and automatically segmenting ischemic stroke lesions from medical imaging data

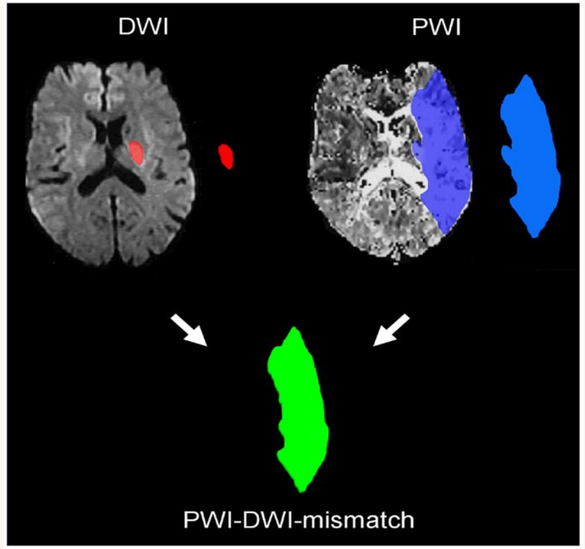


Research

With Deep Learning

Rapid Processing of Perfusion and Diffusion (RAPID) is a widely used imaging software platform designed for the rapid analysis of medical imaging data, including CT and MRI scans.
Focuses on unsupervised, fully automated processing of perfusion and diffusion data for the purpose of expedited routine clinical assessment

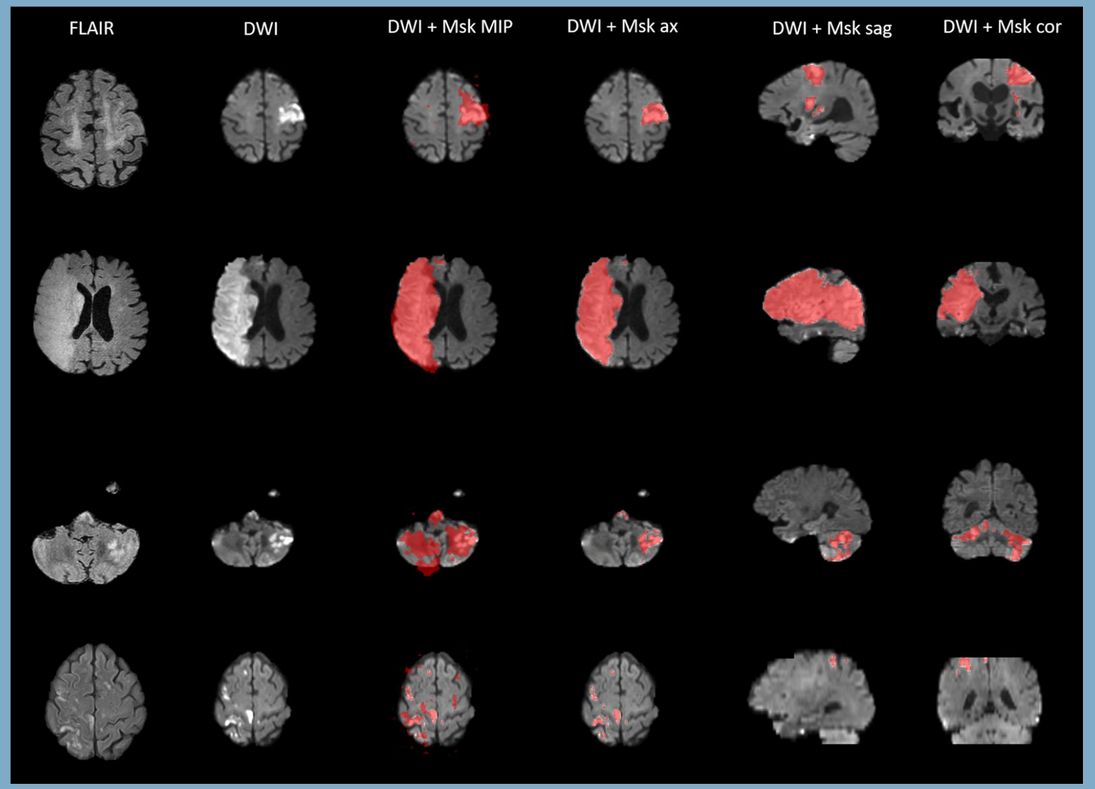




Data

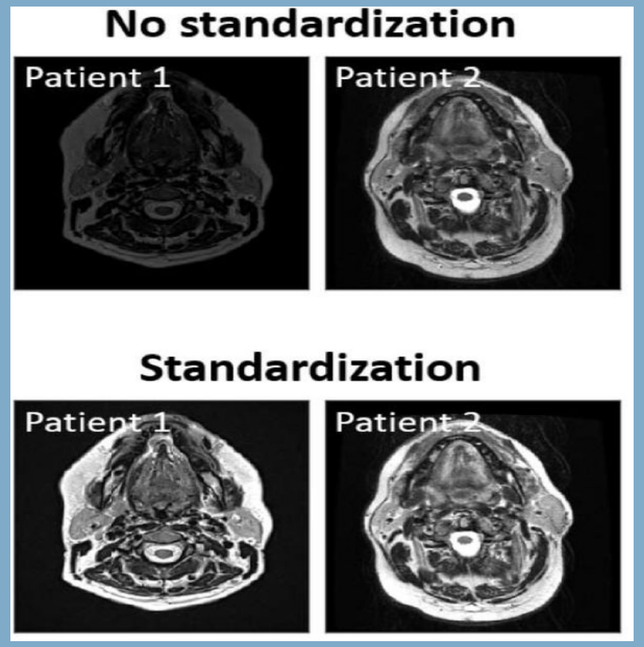
Ischemic Stroke Lesion Segmentation Challenge

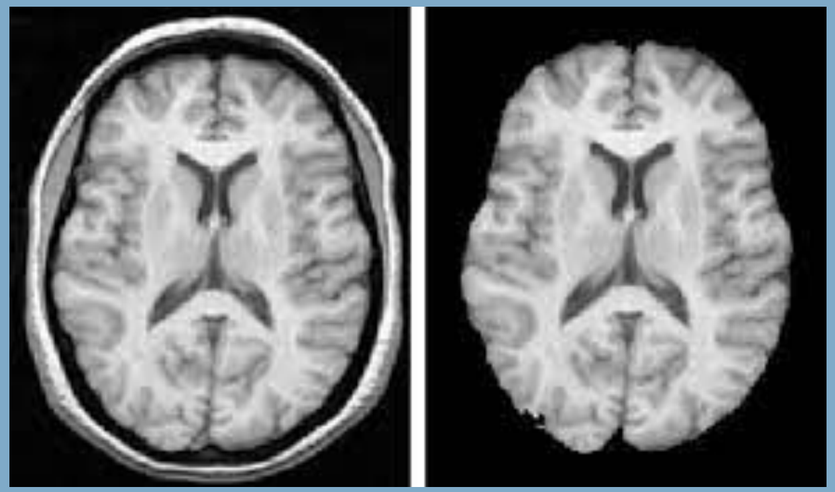
- Data sourced from the Ischemic Stroke Lesion Segmentation Challenge of 2022
- This dataset comprises 400 multi-vendor MRI cases
- high variability in stroke lesion size, quantity and location.
- It is split into a training dataset of n = 250 and a test dataset of n = 150.



Preprocessing

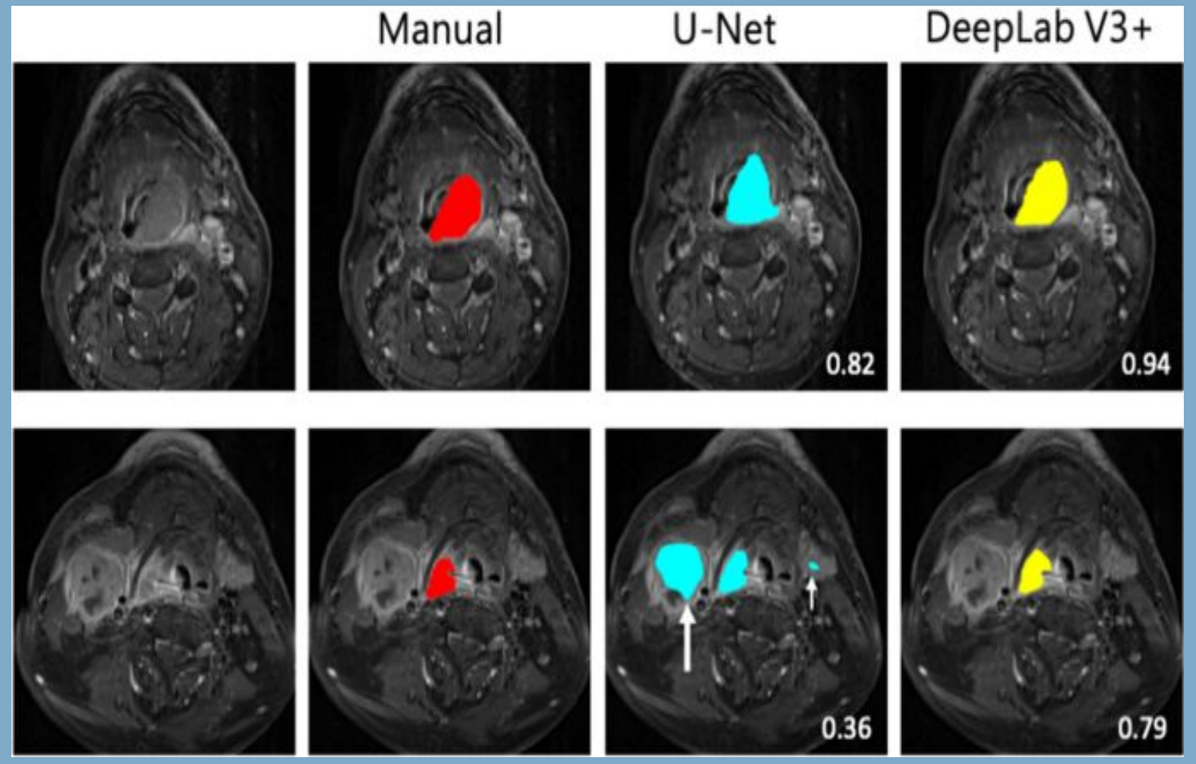
1. Convert DICOM to NIfTI
2. Image registration: align different images of the same patient or anatomical structure to a common coordinate system
3. Intensity Normalization: Normalize the intensity values across different images to make them comparable.





Methods

DeepLab, a deep learning architecture designed for semantic segmentation, can be used to segment infarct and penumbra regions from MRIs by learning patterns and features indicative of these regions.



Annotation methods

3D Slicer:

- 3D Slicer is a powerful, open-source platform for medical image analysis. It supports 2D and 3D image visualization, segmentation, registration, and more.

AIM:

- Annotation and Image Markup (AIM) is a standard developed by the National Cancer Institute (NCI) for representing and sharing annotations on medical images.

Annotator for DICOM:

- Annotator for DICOM is an open-source tool designed for annotating DICOM images. It supports annotation in various formats.