



# MIT Deep Learning: Mastering Neural Networks

## Project Proposal

*“Early Detection of Alzheimer using Neuroimaging Data”*

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## **Introduction**

Cognitive impairments, particularly Alzheimer's disease and its early stage, Mild Cognitive Impairment (MCI), pose a significant global health challenge. Early detection of these conditions is crucial for timely interventions and better patient outcomes. Recent advances in machine learning, coupled with the availability of large neuroimaging datasets, present an opportunity to create powerful tools for accurate diagnosis and differentiation of cognitive impairments.

Cognitive impairments, including Alzheimer's disease, have a profound impact on the quality of life of affected individuals and their families. Early intervention has been shown to slow down the progression of the disease, making early detection a critical factor. These imaging modalities offer a wealth of data that can be leveraged for accurate diagnosis.

Machine learning, particularly Convolutional Neural Networks (CNNs) and advanced feature extraction techniques, has demonstrated remarkable success in image classification tasks. Applying these techniques to neuroimaging data could potentially unlock a powerful tool for early cognitive impairment detection.

The proposed project aims to leverage machine learning techniques to develop a robust and accurate model for the early detection of Dementia using neuroimaging data. The project holds the potential to significantly impact medical research and healthcare by providing a reliable and non-invasive method to identify individuals in the early stages of cognitive decline.

## **Problem Statement**

The primary objective of this project is to develop a machine learning model capable of accurately classifying neuroimaging data into four categories: Mild Demented, Moderate Demented, Non Demented and Very Mild Demented.

By achieving this objective, the project aims to:

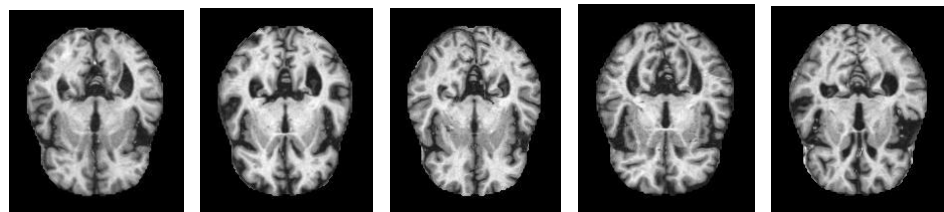
- Provide a reliable and non-invasive method for early detection of *Dementia* and its impact if it is present.
- Assist medical professionals in making informed decisions by offering additional diagnostic support.
- Contribute to the field of medical research by bridging the gap between machine learning and cognitive impairment diagnosis.

## Dataset Description

This dataset splits into two main folders of dataset, i.e., Training and Test,

- **test:** The folder includes **1279** total images divided into 4 folder categories of *Mild Demented* **179** images, *Moderate Demented* **12** images, *Non Demented* **640** images, and *Very Mild Demented* **448** images
- **train:** The folder includes **5121** total images divided into 4 folder categories of *Mild Demented* **717** images, *Moderate Demented* **52** images, *Non Demented* **2560** images, and *Very Mild Demented* **1792** images

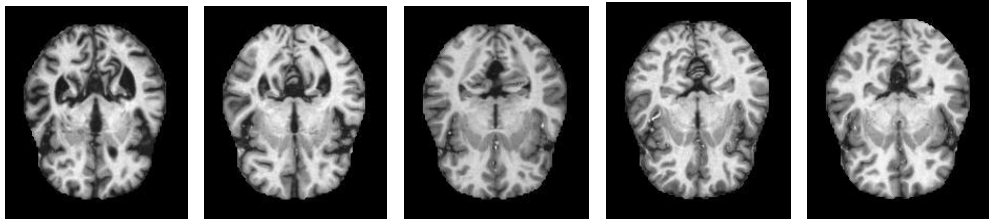
Mild



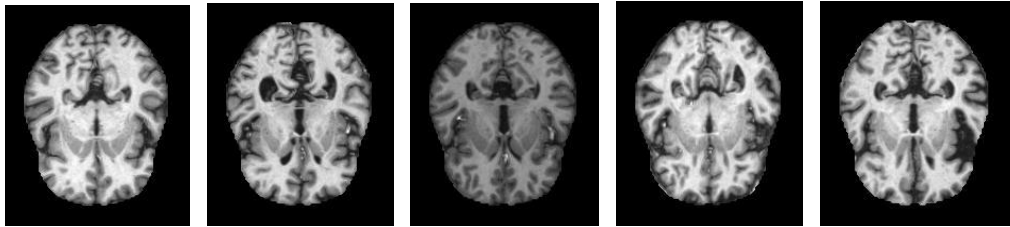
Moderate



Non



Very Mild



## Problem Approach

- **Data Collection and Preprocessing:** Gather a dataset containing neuroimaging data categorized from very mild demented to non demented MRIs. Preprocess the images, perform data augmentation, and extract relevant features.
- **Model Development:** Build and train a machine learning model, with an emphasis on Convolutional Neural Networks (CNNs), to classify images accurately. Experiment with different architectures and hyperparameters.
- **Model Evaluation:** Evaluate the model's performance using appropriate metrics such as accuracy, precision, recall, F1-score, and ROC-AUC. Implement cross-validation to ensure robustness.
- **Interpretability:** If possible, explore methods to make the model's decisions interpretable. Highlighting which regions of the brain contribute most to classification can provide insights for medical professionals.

## Expected Outcomes

Upon successful completion of this project, we anticipate the following outcomes:

- A machine learning model capable of accurately classifying neuroimaging data into Very Mild, Mild, Moderate and Non Demented categories.
- A tool that assists healthcare professionals in early detection of Mild Cognitive Impairment, contributing to timely interventions.
- Insights into the application of advanced machine learning techniques to medical diagnosis, potentially opening avenues for further research.

## References

- Dataset,  
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- Convolutional Neural Networks,  
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- Preventing overfitting,  
<https://developers.google.com/machine-learning/practica/image-classification/preventing-overfitting>
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