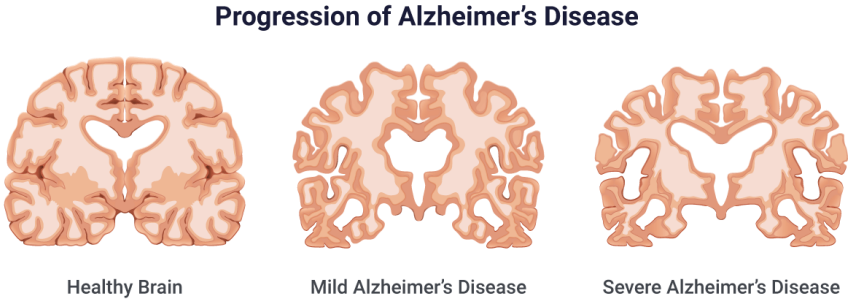
Diagnosing Alzheimer's Through Analysis of MRI Data

A UVA Data Science Case Study by Nina Jannatifar, 2023



https://www.drugwatch.com/health/alzheimers-disease/

Prompt: Alzheimer's Disease (AD) is the leading cause of dementia in the United States, and is a disease of age. As medical interventions improve the longevity of Americans, there is a growing aging population that will be impacted increasingly by this condition. By 2040, Alzheimer's is projected to impact around 12 million people [1]. AD presents with more symptoms than just dementia. Often, caretakers of AD patients notice behavioral changes and impaired judgement before the eventual loss of motor control and inability to carry out basic tasks, requiring increased supervision and care. AD currently has no cure, but early intervention can help improve the quality of a patient's life through the condition's progression. Early detection can help doctors medically intervene to slow or lessen symptoms' severity.

Efforts to improve diagnosis have turned to machine learning. Specifically, there is interest in the use of magnetic resonance imaging (MRI) data to identify progression and using a machine learning algorithm to assist doctors in the process. MRI is a brain imaging technique that shows brain tissue in different planes. [more info on MRI]. AD is a brain pathology that results in tissue atrophy or necrosis, essentially shrinking areas of the brain. This shrinkage can be identified in MRI images. Since machine learning is such a powerful tool, it has the ability to potentially identify brain tissue changes that may be overlooked. Your goal in this project will be to develop and evaluate two models of image analysis using MRI data to determine AD progression.

Task: You will be provided a dataset of MRI images from four categories of AD progression: Very Mild, Mild, Moderate, and no AD. Using this dataset, 1) create a program for image analysis with a convolutional neural network (CNN), 2) research an alternative program and create a second model, and 3) evaluate and compare the performance of the two models.

Deliverables: Successful completion of this case study will involve the creation of a GitHub repository consisting of the following items:

1) CNN model for MRI image classification
2) A second model of student's choice for MRI image classification
3) Brief write-up evaluating the output of the two classification models using a metric of your choice. The paper should justify metric and also discuss the benefits and drawbacks of the two models.

[1] "Fact sheet: U.S. dementia trends," PRB. [Online]. Available: https://www.prb.org/resources/fact-sheet-u-s-dementia-trends/#:~:text=Estimates%20vary%2C%20but%20experts%20report,nearly%2012%20million%20by%202040. [Accessed: 01-May-2023].