

[Link to Dataset](#)

Title: Mapping the Aging Brain: MRI-Based Analysis of Cognitive and Structural Changes in Dementia

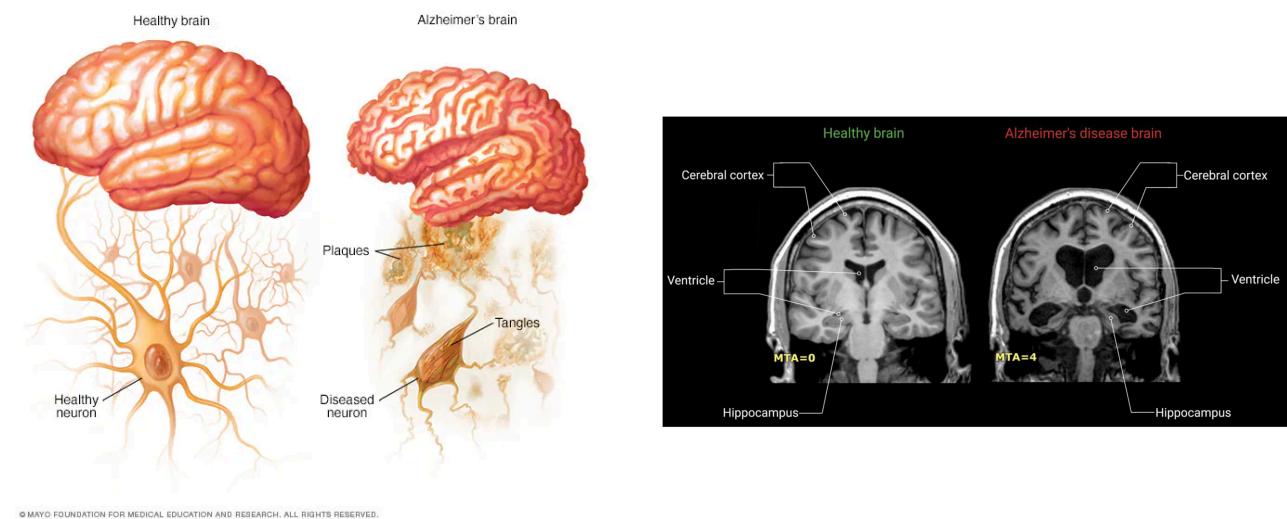
A paragraph to introduce your topic, and why it is important/interesting?

Our project explores how the human brain changes with age and how these changes relate to memory, thinking ability, and diseases like Alzheimer's. Using the OASIS MRI dataset, we look at patterns in brain volume, cognitive scores, and other factors such as education and gender across different age groups. This topic is important because understanding how the brain ages can help scientists and doctors find ways to detect early signs of decline and slow down diseases that affect memory. It is also interesting because it shows how data can reveal the story of the aging brain visually and interactively.

Two reference papers that maybe related to your topic

1. [The clinical use of structural MRI in Alzheimer disease](#)
2. [MRI-Driven Alzheimer's Disease Diagnosis Using Deep Network Fusion and Optimal Selection of Feature](#)
3. [Research on magnetic resonance imaging in diagnosis of Alzheimer's disease](#)

Two static images from online or other sources that may be related to your topic.



An introduction to your data, including the size and source. If you use the online data, please make sure you can load the data. If you decide to collect the data by yourself, just an explanation of how to collect the data will be enough.

The data we are using comes from the Open Access Series of Imaging Studies (OASIS), which provides free MRI data for research on brain structure and aging. We are using two datasets: a cross-sectional dataset with 416 participants aged 18 to 96, and a longitudinal dataset with 150 participants aged 60 to 96 who were scanned two or more times over several years. Each participant has 3 to 4 MRI scans and includes information such as age, gender, years of education, cognitive test scores (MMSE), dementia rating (CDR), and brain volume measurements. The dataset was collected by the Washington University Alzheimer's Disease Research Center and made available online for public use. We have successfully loaded the data in Python using CSV files.

A plan for the later analysis, including any potential pre-processing to the data. What will be the tasks for your analysis and what data visualization (both static and interactive ones are expected) you will include. Please list at least three visualizations you prepare to do.

For the MRI and Alzheimer's dataset, our analysis will focus on understanding how brain structure and cognitive decline are interconnected across aging and dementia progression. Before conducting the analysis, we will preprocess the data by handling missing values, normalizing MRI-derived measures such as estimated total intracranial volume (eTIV) and normalized whole-brain volume (nWBV), encoding categorical variables like gender and cognitive status, and removing potential outliers to ensure data consistency. The key tasks will include exploring age-related patterns in brain atrophy, comparing cognitive performance across demographic and MRI measures, and visualizing the relationships between MRI biomarkers and dementia status. To effectively communicate findings, we plan to include several visualizations. A 3D diagram showing the decline in brain volume or regions affected by Alzheimer's disease will provide a spatial understanding of brain atrophy. A scatterplot of brain volume versus age will help reveal correlations between aging and reductions in brain volume, potentially differing between dementia and non-dementia groups. Additionally, an age distribution plot by cognitive status (dementia vs. non-dementia) will highlight demographic differences and trends in diagnosis. Finally, a visualization comparing cognitive function and brain volume will illustrate how reductions in brain volume are associated with cognitive decline. These visualizations, both static and interactive, will provide meaningful insights into how structural brain changes relate to cognitive deterioration in Alzheimer's patients.

Describe each group member's duties.

Both group members will collaborate equally on every part of the project, including data cleaning, preprocessing, and analysis of the MRI and Alzheimer's dataset. We will work together to design and implement both static and interactive visualizations, ensuring consistency in style and interpretation across all figures. Additionally, we will jointly contribute to the website creation, proposal writing, and final presentation to reflect equal effort and shared responsibility throughout the project.