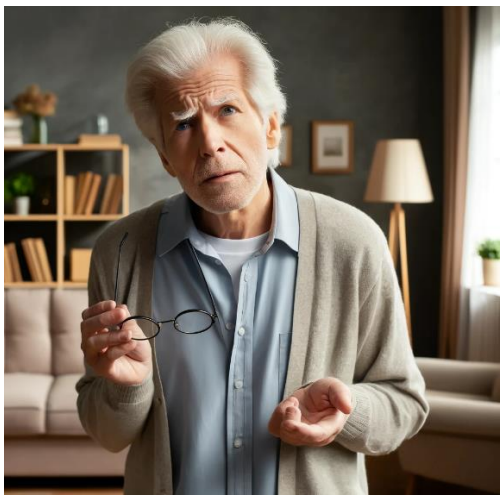
What is Alzheimer’s disease?

Alzheimer's disease is a brain disorder that gradually destroys memory and thinking skills and eventually the ability to carry out simple tasks. It typically starts slowly and worsens over time, becoming severe enough to interfere with daily activities. Alzheimer's is the most common cause of dementia among older adults. It involves parts of the brain that control thought, memory, and language. Although the exact cause isn’t fully understood, it involves a buildup of proteins in the brain, leading to the death of brain cells. There is no cure, but treatments can help manage symptoms and improve quality of life.



Why do we choose this disease?

Alzheimer's is one of the most common causes of dementia among older adults, affecting millions worldwide. The disease has a profound impact not only on patients but also on their families and caregivers. As populations age, the prevalence of Alzheimer's is expected to increase, making it a significant public health concern. Alzheimer's disease imposes a heavy economic burden on societies due to the high costs of healthcare and caregiving.

Despite considerable research, Alzheimer's remains without a cure, and treatments are limited. Studying this disease is crucial for developing effective early detection methods and treatments that could significantly improve quality of life and potentially delay or prevent the progression of symptoms in those at risk.

Dataset:

1. **Subject ID**: A unique identifier for each subject in the study, ensuring each participant’s data remains distinct and traceable throughout the study.
2. **MRI ID**: A unique identifier for each MRI scan performed on the subjects, crucial for linking neuroimaging data to individual records.
3. **Group**: The classification of cognitive status of the subjects, categorized into 'Nondemented', 'Demented', and 'Converted' (subjects who progressed from nondemented to demented during the study).

4. **Visit**: Represents the number of visits or assessments each subject has undergone, useful for longitudinal analysis of progression.
5. **MR Delay**: The number of days between the first visit and the subsequent visits.
6. **M/F**: Gender of the subject, indicated as 'M' for male and 'F' for female, as gender may influence the risk or progression of Alzheimer's.
7. **Hand**: Indicates the dominant hand of the subject ('R' for right-handed), though this is less directly related to Alzheimer's, it can be relevant in neurological assessments.
8. **Age**: The age of the subject at each visit, a critical factor since Alzheimer's risk increases significantly with age.
9. **EDUC**: Represents the years of education completed by the subject, as educational level can impact cognitive reserve and the risk of dementia.
10. **SES**: Socioeconomic status, typically a numerical value, which may correlate with various health outcomes including the risk and progression of cognitive decline.
11. **MMSE**: Mini-Mental State Examination score, a standard tool used to measure cognitive impairment and screen for dementia.
12. **CDR**: Clinical Dementia Rating, quantifying the severity of dementia symptoms, which helps in staging the disease and planning treatment.
13. **eTIV**: Estimated Total Intracranial Volume, measuring the overall brain volume, relevant in studying brain atrophy patterns in dementia.
14. **nWBV**: Normalized Whole Brain Volume, related to the overall size of the brain adjusted for head size, often used in research to gauge brain shrinkage.
15. **ASF**: Atlas Scaling Factor, used in neuroimaging to standardize brain volume measurements across different individuals and scanners.

To gather the features in Alzheimer's dataset, several methods and sources are typically employed. These approaches encompass a combination of clinical assessments, neuroimaging techniques, and demographic data collection. Here's how each type of feature can be acquired:

Clinical Assessments:

- **MMSE (Mini-Mental State Examination)**: This is a brief 30-point questionnaire test that is used to screen for cognitive impairment. It includes tasks to assess functions such as arithmetic, memory, and orientation.
- **CDR (Clinical Dementia Rating):** This rating is obtained through an interview process that evaluates the presence and severity of dementia symptoms in five domains: memory, orientation, judgment, and problem solving, community affairs, home and hobbies, and personal care.

Neuroimaging Techniques:

- **MRI (Magnetic Resonance Imaging)**: Neuroimaging can provide important data on brain structure and function. The eTIV (estimated total intracranial volume), nWBV (normalized whole brain volume), and ASF (atlas scaling factor) are derived from MRI scans. These measurements are crucial for understanding changes in brain volume and structure that may be associated with cognitive decline.

Demographic and Socioeconomic Data Collection:

- **Age, Gender, Education, Socioeconomic Status (SES)**: These data are generally collected through questionnaires or interviews during the clinical visit. Age and education level are straightforward to record, whereas SES might be assessed based on occupation, income level, or education.
- **Hand Dominance:** This information can be gathered by asking the individual which hand they predominantly use for tasks like writing.

Tracking Clinical Visits and Delays:

- **Visit Number and MR Delay:** These are logistical details that can be tracked through the clinical data management system where each visit and the corresponding MR imaging are recorded along with dates. This helps in analysing the progression over time.

Unique Identifiers:

- **Subject ID and MRI ID:** These are typically generated by the data management system used in the study to uniquely identify and track each subject's records and their corresponding MRI scans without revealing personal identifying information.

Prediction models:

For our study, we used traditional machine learning models to build the prediction model due to the limited size of the dataset. Deep learning techniques were not employed as they typically require much larger amounts of data to perform effectively and to avoid overfitting.

The machine learning models that we used, and the results are listed below.

Machine Learning Model	Accuracy
K-Means Clustering	88%
Support Vector Machine (SVM)	88%
Logistic Regression	89.3%
Decision tree	88%
Random forest	91%
ADA Boost	89%

Conclusion:

In conclusion, Alzheimer's disease is one of the most prevalent conditions among the elderly in Australia. Integrating our predictive model into wearable technology could significantly aid in the early detection of this disease, providing crucial advancements in care and management. To enhance this approach further, collecting more comprehensive data would enable the development of deep learning models, potentially increasing the accuracy and reliability of predictions. This progression holds promise for significantly improving the quality of life for elderly individuals by facilitating earlier and more precise interventions.