IT3389 – Applied AI Project

Diploma in Applied AI and Analytics (DAAA)

School of Information Technology

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Nasrullah,

APPENDIX A – FORM FOR SUBMITTING PROJECT TEAM ORGANISATION

Module Group: **2 and 3**

Project Group Number: Group 4

Team Name (optional): Group 4

S/n	Name	Roles	Admin No.	Handphone	Personal email
1*	Nasrullah	Product Owner	214326Z	94238345	nasrullahnazaruddin@gmail.com
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*denotes the Team Leader

MILESTONE REPORT

Introduction

Our specialized AI and healthcare team collaborates with Synapxe, a major health-tech agency in Singapore, and SingHealth to address the pressing issue of dementia diagnosis and prevention. As Singapore's aging population faces a growing dementia challenge, our project focuses on providing vital home care support. With dementia cases projected to rise, early detection and prevention become paramount for patient and family well-being.
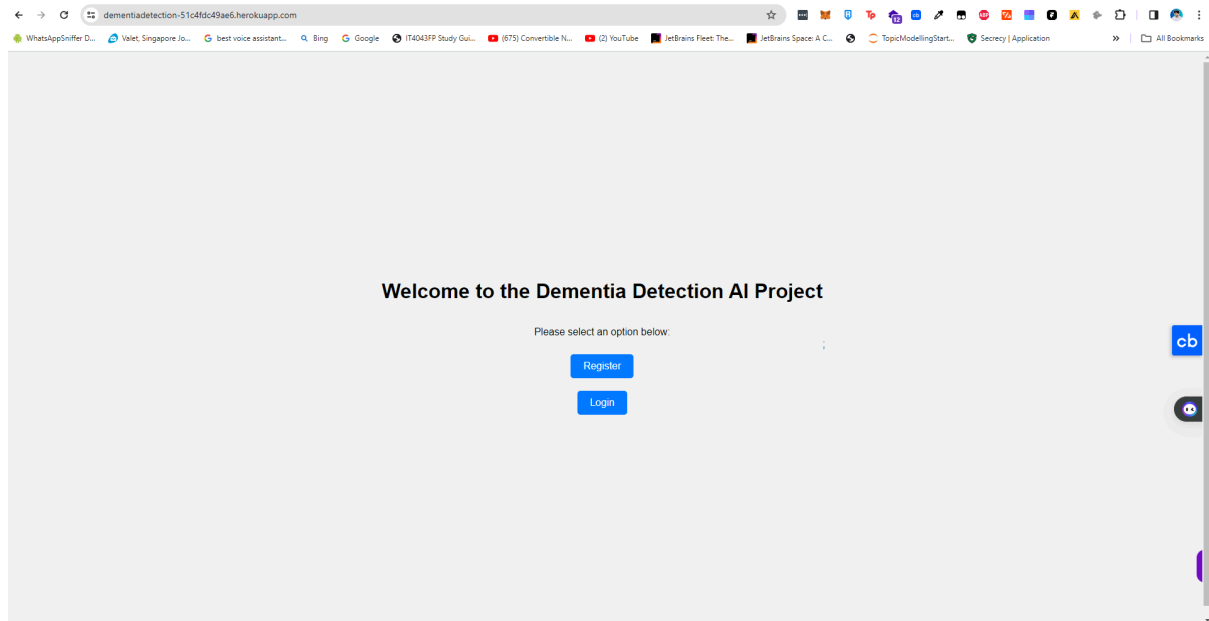
Deployed Pipeline and Web Application

Deployed to the web application:

https://dementiadetection-51c4fdc49ae6.herokuapp.com/

Github Repo: https://github.com/boss2256/Dementia-AI-Detection

Register/Login as Admin:

Register:

Log-In:

Go to Reports and Make Prediction:

Problem Statement

Dementia is a leading cause of disability and death among the elderly. Its gradual onset often leads to delayed diagnosis, complicating care. Our mission is to develop technology-driven solutions for early detection and continuous monitoring of dementia, alleviating the burden on patients and caregivers.

Approach

We'll leverage MLOps for efficient model deployment and follow the CRISP-DM methodology for structured data mining and AI model development. Our solution aligns with Singapore's healthcare goals, addressing a critical community need.

Supporting Data:

The project will be supported by data and statistics from credible sources such as medical journals and dementia research organizations. Feedback from healthcare professionals will also play a critical role in shaping the solution.

Data Source:
https://www.kaggle.com/datasets/kaggler2412/dementia-patient-health-and-prescriptions-dataset/data

Dataset CSV: dementia_patients_health_data.csv

Content of data:

- **Diabetic (Binary)**: Indicates whether a patient has been diagnosed with diabetes (1 for yes, 0 for no).
- **Alcohol Level (Continuous)**: Measures the alcohol consumption level of patients, possibly reflecting lifestyle choices.
- **Heart Rate (Continuous)**: Denotes the number of heartbeats per minute, a critical indicator of cardiovascular health.
- **Blood Oxygen Level (Continuous)**: The saturation of oxygen in the blood, a vital sign of respiratory function.
- **Body Temperature (Continuous)**: The measured temperature of the body in Celsius, indicating potential fever or hypothermia.
- **Weight (Continuous)**: The mass of the patient in kilograms, a fundamental measure of health.
- **MRI Delay (Continuous)**: The time delay in obtaining an MRI scan, potentially indicative of the progression or severity of medical conditions.
- **Prescription**: The specific medication prescribed to the patient, relevant for treatment analysis.
- **Dosage in mg (Continuous)**: The amount of medication prescribed, is critical for dosage-effect studies.
- **Age (Continuous)**: The age of the patient, is an essential demographic factor.
- **Education_Level**: The highest level of education attained by the patient, which may correlate with health literacy.
- **Dominant_Hand**: Indicates the dominant hand of the patient, which could relate to neurological functions.
- **Gender**: The gender of the patient, is a key demographic characteristic.
- **Family_History**: Indicates a family history of dementia, a significant risk factor.
- **Smoking_Status**: Reflects the patient's smoking habits, an important lifestyle indicator.
- **APOE_ε4**: Shows the presence of the APOE ε4 allele, a genetic variant associated with Alzheimer's disease.
- **Physical_Activity**: The level of physical activity of the patient, highlighting lifestyle impacts on health.
- **Depression_Status**: Indicates whether the patient has depression, which can be related to cognitive health.
- **Cognitive_Test_Scores (Continuous)**: Scores from cognitive tests, direct measures of cognitive function.
- **Medication_History**: Records whether the patient has a history of medication use, relevant for drug interactions.
- **Nutrition_Diet**: Describes the patient's diet, an important health factor.
- **Sleep_Quality**: Assesses the quality of the patient's sleep, a critical aspect of health.

- **Chronic_Health_Conditions**: Notes any chronic health conditions the patient has, key for comorbidity studies.
- **Dementia (Binary)**: Serves as the target variable, indicating the presence (1) or absence (0) of dementia.

Hypothesis

Early Diagnosis:

Hypothesis: By developing an AI model that analyzes medical data and cognitive patterns, we can achieve early diagnosis of dementia in individuals, allowing for timely interventions and improved patient outcomes.

Outcome: Early detection of dementia, enabling early treatment and support, which leads to better patient quality of life and reduced healthcare costs.

Medication Management:

Hypothesis: By implementing AI-driven medication management systems, we can ensure that dementia patients receive their medications accurately and on time, leading to better symptom management and overall health.

Outcome: Reduced medication errors, improved symptom control, and enhanced patient well-being.

Data Points for Distinguishing Dementia

1. Cognitive Test Results: Changes in cognitive abilities over time.
2. Brain Imaging Data: Specific patterns or changes in brain structure.
3. Patient History and Demographics: Age, education level, genetic factors.
4. Health Metrics: Blood pressure, other health conditions.

Proposed Solution

Features:

1. **Cognitive Test Integration:** We offer tools for administering and analyzing cognitive tests, notably the Clock Drawing Test, to facilitate early detection of dementia.

2. **MRI Image Analysis**: Our AI algorithms are trained to interpret MRI images, enabling the early identification of dementia-related signs.
3. **Data Tracking Dashboard:** An intuitive and user-friendly dashboard that displays patient data over time, integrating visualization tools for clear trend interpretation.
4. **AI Model for Analysis:** We develop a sophisticated AI model, leveraging datasets from sources like Kaggle and Alzheimer's research institutions. This includes data preprocessing, the selection of appropriate deep-learning models, and the implementation of cross-validation techniques for robust analysis.
5. **Data Security and Management:** Our system prioritizes the secure and compliant management of patient data, adhering to privacy regulations.
6. **Treatment Recommendations:** Based on AI analysis, the system can provide valuable suggestions for potential interventions or further diagnostic steps.
7. **Model Evaluation Metrics:** We utilize a range of performance metrics including accuracy, precision, recall, F1 score, and AUC-ROC for image analysis, ensuring the reliability of our AI model.

Project Planning

Milestones:

1. **Data Collection and Preparation:** Identify and prepare datasets for AI training, including MRI images and cognitive test results.
2. **AI Model Development**: Train the AI model using cloud platforms like AWS or Google Vertex AI. This includes model selection, training, cross-validation, and performance evaluation using suitable metrics.
3. **Web Application Development:** Create a Flask-based web app for data input and visualization.
4. **API Integration and Testing:** Develop a REST API to connect the AI model with the web app.
5. **User Interface Design:** Design a user-friendly interface for ease of use by healthcare professionals.
6. **Deployment and Feedback Collection:** Deploy the application and gather feedback for iterative improvements.

Week 16 (Building the Web App and Pipeline on Jupyter Notebook)

Web App Architecture
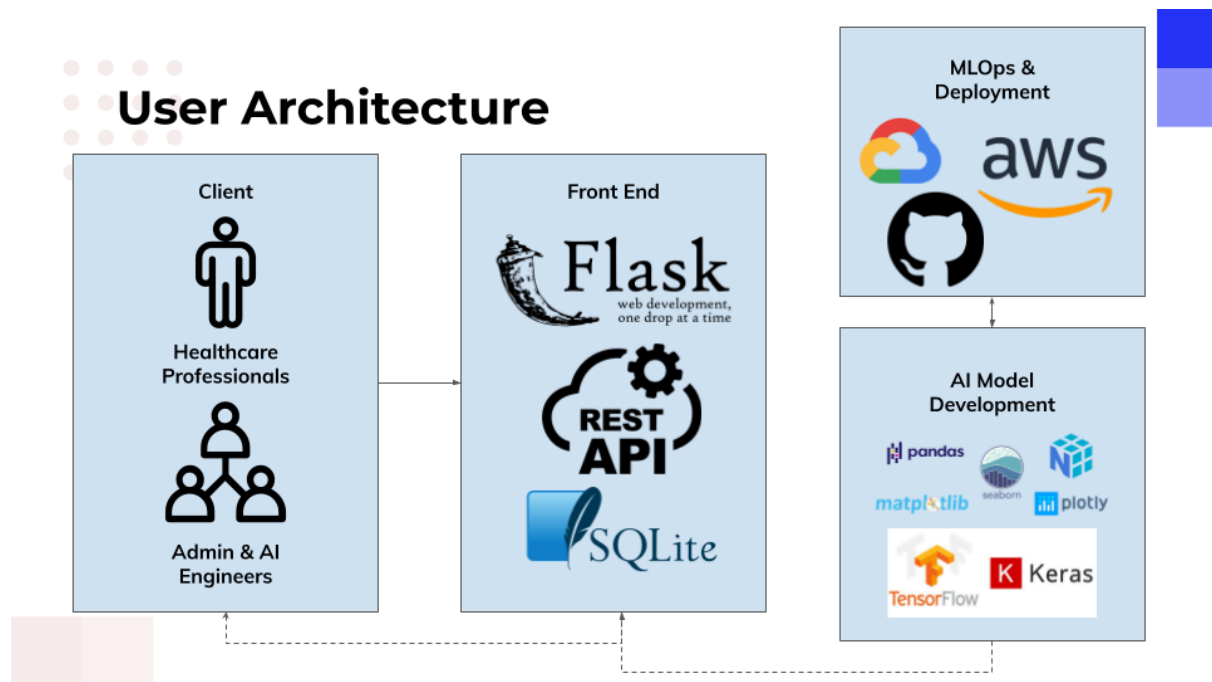
Continuous Integration/Continuous Deployment (CI/CD) practices will be implemented using GitHub, enabling automated and efficient deployment to the web application. User authentication and data management will be handled using the lightweight SQLite database system, ensuring a secure and reliable login experience for healthcare professionals and family members.
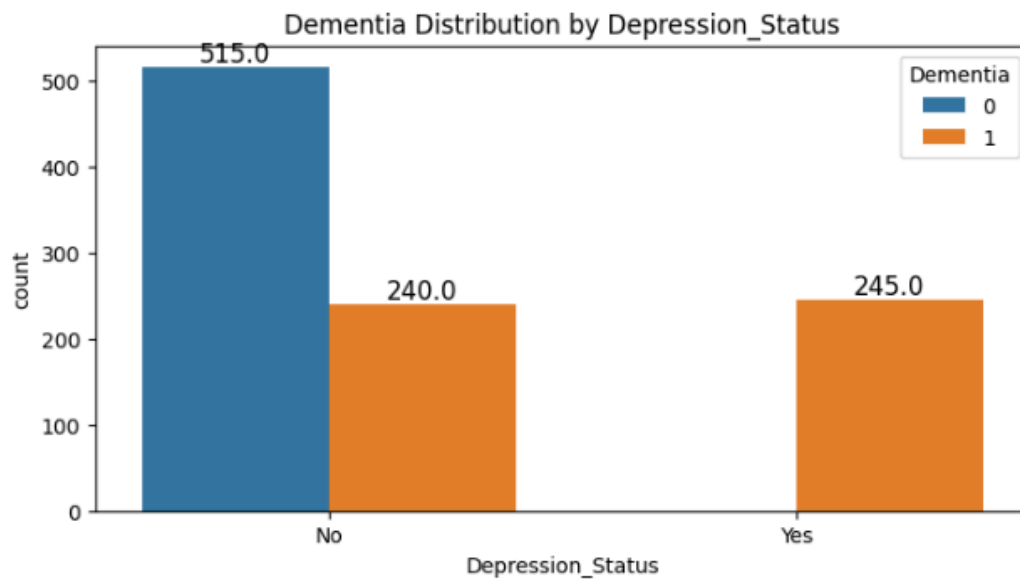
The machine learning model will be deployed locally, accessible through a RESTful API, and connected to the front-end interface for user interaction. Ultimately, the project will result in a fully functional web application, hosted on a cloud platform, that addresses the critical need for dementia diagnosis and management.

Miscellaneous

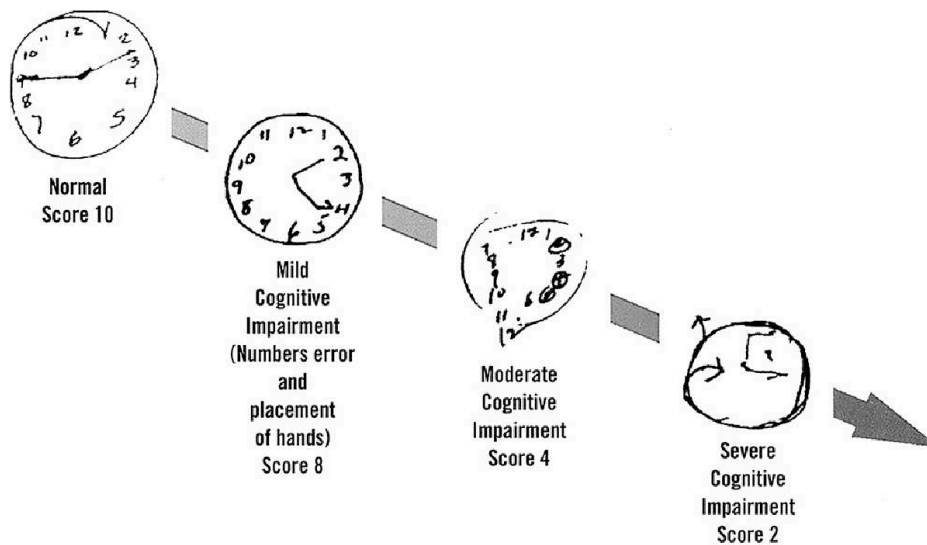Correlation Matrix of Encoded Features (Thresholded)

Within our correlation matrix analysis, we have identified strong correlations among several key variables. Notably, there is a significant positive correlation between depression, APOE ε3 status, cognitive test scores below 8, educational background (specifically, 'school' variables), and diabetes. This implies that individuals with lower cognitive test scores and a history of depression are more likely to exhibit certain educational backgrounds, such as 'school' variables, and potentially have a higher prevalence of diabetes. Understanding these correlations is essential as it sheds light on potential interdependencies among these factors, which could be vital for designing targeted interventions and predictive models in the context of our project.

EDA (More in Jupyter Notebook):

Dementia Distribution by Depression_Status

Depression within the context of dementia is a pressing concern that necessitates a thorough understanding due to its substantial prevalence. Recent studies indicate that an alarming 20 to 30 percent of individuals living with dementia grapple with depressive symptoms, shedding light on the urgency of addressing this complex intersection of mental health and cognitive decline.

Cognitive Test Scores (Clock Drawing Test):

Normal Score 10 → Mild Cognitive Impairment (Numbers error and placement of hands) Score 8 → Moderate Cognitive Impairment Score 4 → Severe Cognitive Impairment Score 2

The utilization of cognitive testing through the Clock Drawing test emerges as a pivotal tool in the identification of early signs. Notably, the results of such tests carry profound implications for understanding the cognitive well-being of individuals. It is crucial to recognize that a cognitive test score falling within the range of 8-10 points may not exhibit overt signs of dementia, while a score below 8 serves as an indicative marker of cognitive decline.

References:

Medicine:

1. https://www.nia.nih.gov/health/alzheimers-treatment/how-alzheimers-disease-treated#:~:text=Galantamine%2C%20rivastigmine%2C%20and%20donepezil%20are,some%20cognitive%20and%20behavioral%20symptoms.
2. https://www.nia.nih.gov/health/alzheimers-treatment/how-alzheimers-disease-treated#:~:text=Galantamine%2C%20rivastigmine%2C%20and%20donepezil%20are,some%20cognitive%20and%20behavioral%20symptoms.
3. https://pubmed.ncbi.nlm.nih.gov/3684456/#:~:text=Abstract,runs%20a%20more%20rapid%20course.

Kaggle:

1. https://www.kaggle.com/datasets/kaggler2412/dementia-patient-health-and-prescriptions-dataset
2. https://www.kaggle.com/datasets/lukechugh/best-alzheimer-mri-dataset-99-accuracy