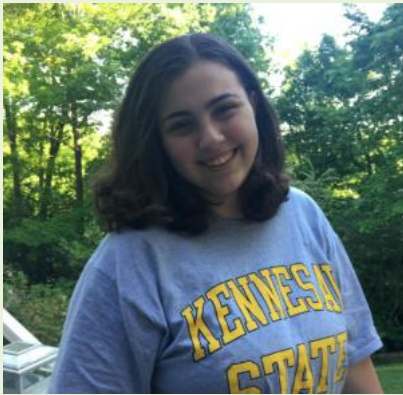# CZ-1 DL Alzheimer's

Software Test Plan and Software Test Report

CS 4850 - Sections 02 & 04 - Fall 2025
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Table of Contents

1. Overview

1.1. Purpose

The objective of this test plan is to validate that the Alzheimer's Diagnosis system meets the functional and non-functional requirements defined in the Software Design Documentation. Specifically, we aim to:

– Verify that the MRI images are correctly ingested, segmented, and normalized
– Confirm the chosen ML model can generate predictions with accuracy comparable to similar cutting-edge technologies, distinguishing confidently between AD, MCI, and NC
– Ensure the system runs efficiently and safely

1.2. Scope

The scope of this project testing phase is bound by the following:

– Validate the data processing pipeline, check for any quality errors
– Test our python implementation of our model
– Evaluate for accuracy and efficiency
– Generate and verify classification matrices for each binary classification output

2. Testing Summary

2.1. Scope of Testing

2.1.1. In scope

The scope of this project's testing phase is primarily bound by the validation of the data processing pipeline, ensuring that all data is free from quality errors before ingestion. We will specifically test the Python implementation of our model, evaluating for both accuracy and computational efficiency, while also generating and verifying classification matrices for every binary classification output.

2.1.2. Out of scope

Because this project focuses on the research and functional aspects of the technology rather than consumer-facing design, a graphical user interface (GUI) is considered out of scope for this testing phase. Since this program is designed to run on research computers with access to the internet, mobile applications are also out of scope for this project.

3. Analysis of Scope and Test Focus Areas

3.1. Release Content

This release encompasses the complete CZ-1 Deep Learning Alzheimer's Diagnosis system, designed to aid researchers in staging Alzheimer's Disease (AD) progression. The content includes the full data preprocessing pipeline utilizing MATLAB scripts with SPM12 and CAT12 toolboxes for image segmentation and Region of Interest (ROI) extraction. It also delivers the Python-based machine learning suite, which contains implementations of five distinct models: Neural Network, K-Nearest Neighbors (KNN), Random Forest, Support Vector Machine (SVM), and Logistic Regression. Additionally, the release contains the consolidated dataset merging ADNI, AIBL, and OASIS3 source data into unified CSV formats for training and validation.

3.2. Regression Testing

Regression testing is required for this release to ensure that iterative improvements to the model parameters and preprocessing scripts do not negatively impact previously stable system functionalities and efficiencies. Regression tests must confirm that the data ingestion pipeline remains robust, successfully processing standard MRI formats (.nii) and generating valid CSV outputs *without errors*, ensuring that new code changes have not introduced regressions in the model performance.

4. Progression Test Objectives

Ref	Function	Test Objective	Evaluation Criteria	X-Ref	P
SVM-01	Support Vector Machine Testing	Determine if model is sufficient in Accuracy, Specificity, Efficiency, and F1-Score	– Model Accuracy – Model Specificity – PCA Number – Model Efficiency – Confusion Matrix	None	High
AIBL-01	Dataset Alignment and Quality Testing	Determine if dataset contains high quality data which can be ingested easily into all ML models	– SPM Quality Score – Confusion Matrix – Model Accuracy	None	Med
ADNI-01	Dataset Alignment and Quality Testing	Determine if dataset contains high quality data which can be ingested easily into all ML models	– SPM Quality Score – Confusion Matrix – Model Accuracy	None	Med
OASIS-01	Dataset Alignment and Quality Testing	Determine if dataset contains high quality data which can be ingested easily into all ML models	– SPM Quality Score – Confusion Matrix – Model Accuracy	None	Med
ALL-01	Dataset Alignment and Quality Testing	Determine if dataset contains high quality data which can be ingested easily into all ML models	– SPM Quality Score – Confusion Matrix – Model Accuracy	None	High

5. Regression Test Objectives

Ref	Function	Test Objective	Evaluation Criteria	X-Ref	P
SVM-02	Support Vector Machine Testing	Determine if a previous version (Version 8) of the model is sufficient in Accuracy, Specificity, Efficiency, and F1-Score	– Model Accuracy – Model Specificity – PCA Number – Model Efficiency – Confusion Matrix	None	Low
SVM-03	Support Vector Machine Testing	Determine if a previous version (Version 9) of the model is sufficient in Accuracy, Specificity, Efficiency, and F1-Score	– Model Accuracy – Model Specificity – PCA Number – Model Efficiency – Confusion Matrix	None	Med
ALL-02	Dataset Quality and Alignment Testing	Determine if a subset of full dataset (ADNI-Oasis only) contains high quality data which can be ingested easily into all ML models	– SPM Quality Score – Confusion Matrix – Model Accuracy	None	Med

6. Test Strategy

6.1. Test level responsibility

Test Level	Jordan	Julia
Database Testing	P	S
Model Testing		P
Data Ingestion Testing	S	P
Final Model Testing		P

6.2. Test Type & Approach

Test Type	Objectives
Progression Requirements	The objectives are to verify that the application: – Meets the defined requirements; – Performs and functions accurately; – Correctly handles error conditions; – Interfaces function correctly; – Data load is successful.
Regression testing	The objectives are the following: – Ensure adjustments made to the model do not negatively impact performance – Ensure integrated system maintains security and integrity – Confirms that the end-to-end data processing is not affected by the model processing

6.3. Facility, data, and resource provision plan

6.3.1. Testing Requirements

Testing will require access to the following materials:
– A computer with access to a Python Compiler / IDE, and sufficient RAM
– A storage device with access to the ADNI, AIBL, and Oasis3 Databases
– A resource with internet technologies understanding.

6.4. Testing Tools

The following tools were used for testing:

Process	Tool
Test Case Creation	Microsoft Word
Test Case Tracking	Microsoft Excel
Test Case Execution	Python Compiler / IDE
Defect Management	Microsoft Excel

6.5. Testing Metrics

We use the a combination of the following values to gauge success according to our tests:
- SPM Quality Score
- Confusion Matrix
- Model Accuracy
- Model Specificity
- PCA Number
- ROC Curves
- Model Efficiency

7. Assumptions and Dependencies

7.1. Assumptions

When testing, we will assume the following:
- The user has access to all datasets
- All datasets have been pre-processed through SPM and Cat12
- User is running the model on a sufficiently powerful computer

7.2. Dependencies

Our tests are dependent on the following:
- The user has a suitable computer
- Referenced pathways in the code have not been changed by the user

8. Software Testing Report

Requirement	Pass	Fail	Severity
SVM-01	P		Medium, met expectations (~70% accuracy)
AIBL-01		F	High, contained bad data points
ADNI-01	P		Medium, met expectations
OASIS-01	P		Medium, met expectations
ALL-01	P		Medium, met expectations
SVM-02		F	Low, performed slightly below expectations (~65% accuracy)
SVM-03	P		Low, met expectations but missing cross validation
ALL-02	p		Medium, met expectations (~70% accuracy)

9. Definitions

The following acronyms and terms have been used through out this document

Term/Acronym	Definition
SPM	Statistical Parametric Mapping
SVM	Support Vector Model
ADNI	Alzheimer's Disease Neuroimaging Institute
Oasis	Open Access Series of Imaging Studies
AIBL	Australian Imaging Biomarkers and Lifestyle Study
PCA	Principal Component Analysis, used to reduce dimensionality
CAT12	MATLAB toolbox used for processing MRI images
ROC	Receiver Operating Characteristic

10. Points of Contact

The following people can be contacted in reference to this document

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