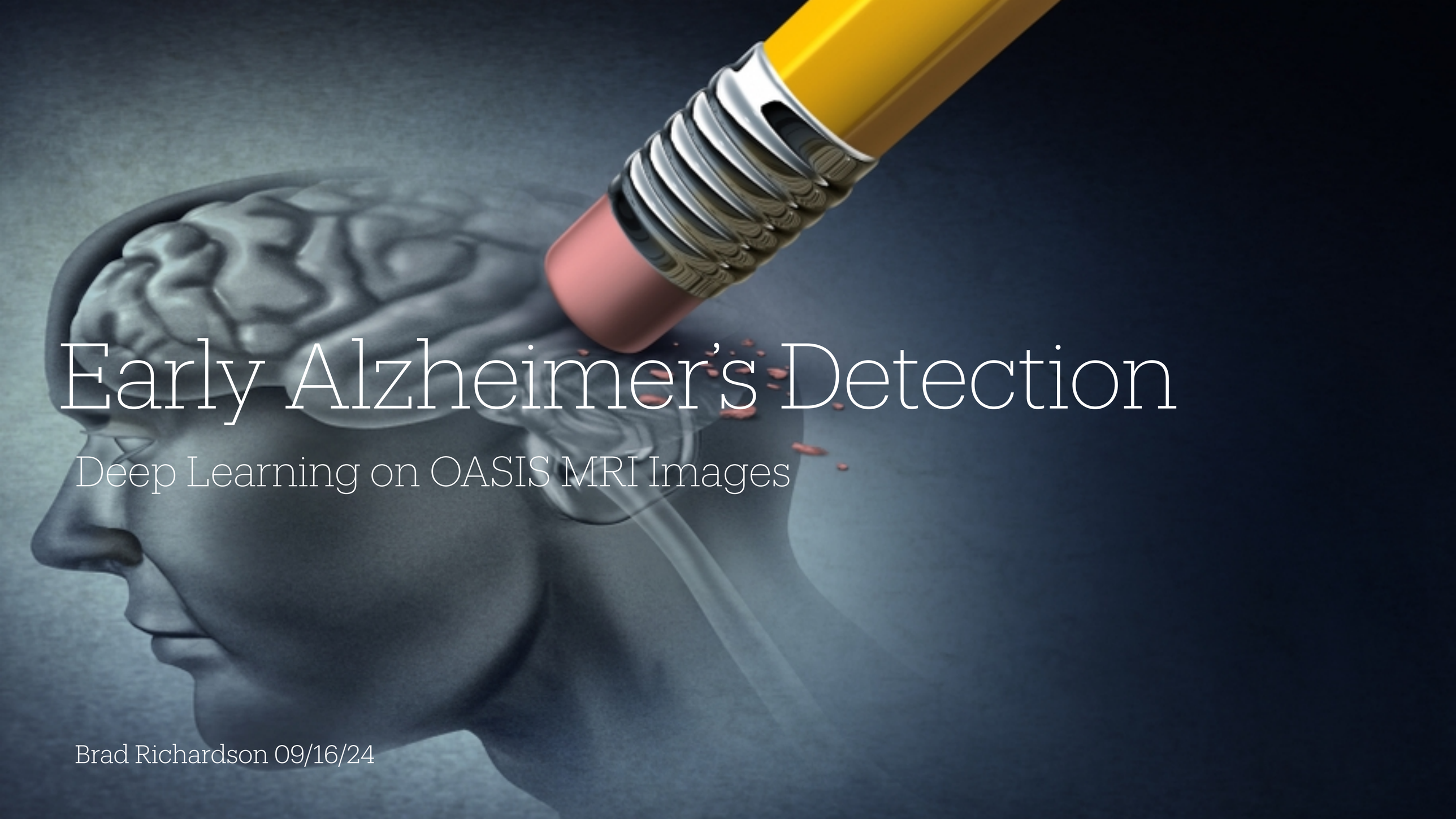


Early Alzheimer's Detection

Deep Learning on OASIS MRI Images

Brad Richardson 09/16/24

Motivation

- Alzheimer’s and dementia run in my family
- primary caregiver for my 87 year old grandma who was diagnosed
- Worked in healthcare for 10 years prior to joining program
- Took Intro to AI last semester and looking to practice!

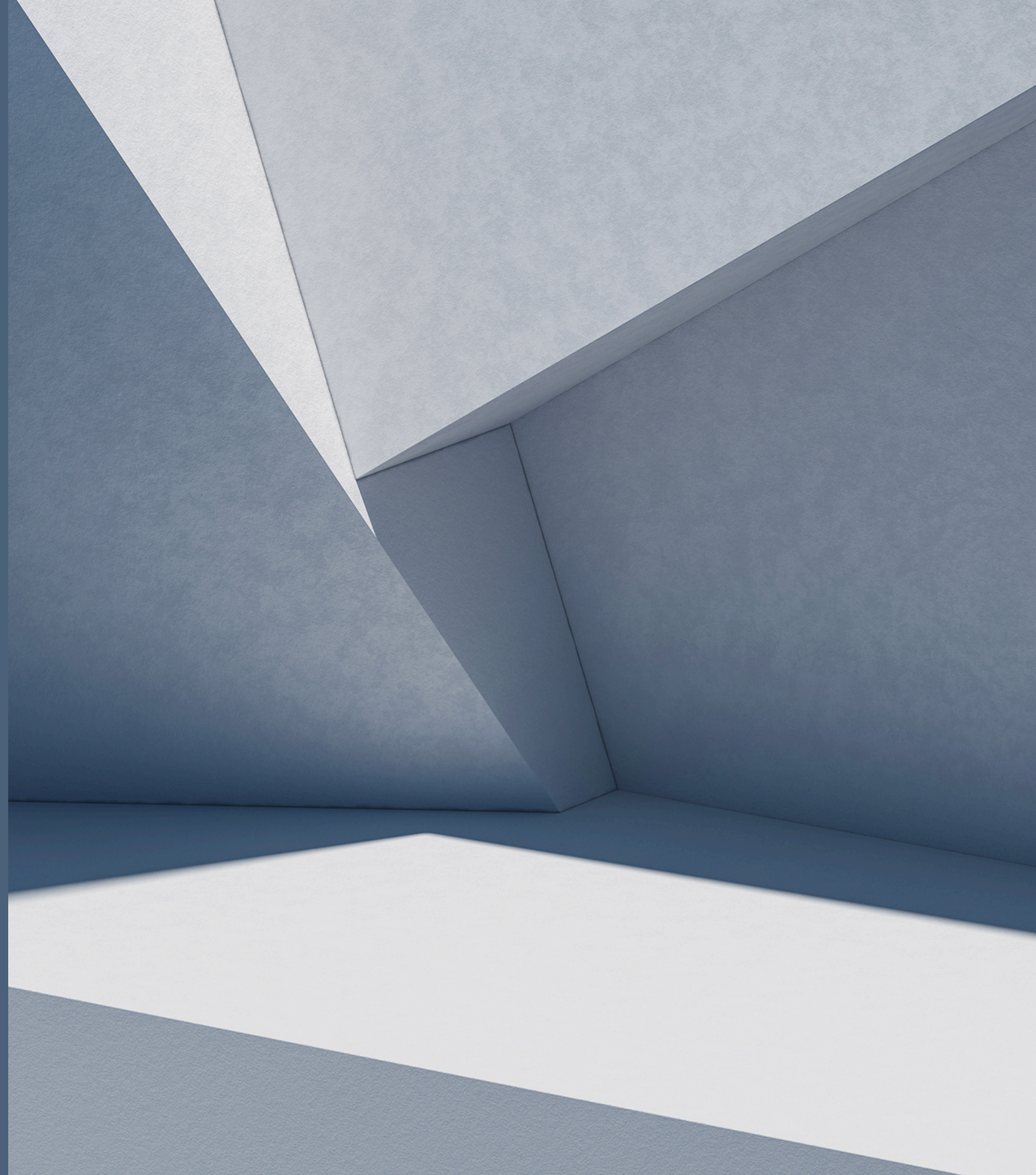
Project Description

- This project seeks to develop a deep learning model using convolutional neural networks (CNNs) to classify MRI brain images into four categories reflecting the stages of Alzheimer's disease: non-demented, very mild demented, mild demented, and demented.

- By utilizing the extensive OASIS MRI dataset of 80,000 images, we aim to explore how effectively CNNs can detect and differentiate the subtle changes in brain images corresponding to early stages of Alzheimer's.

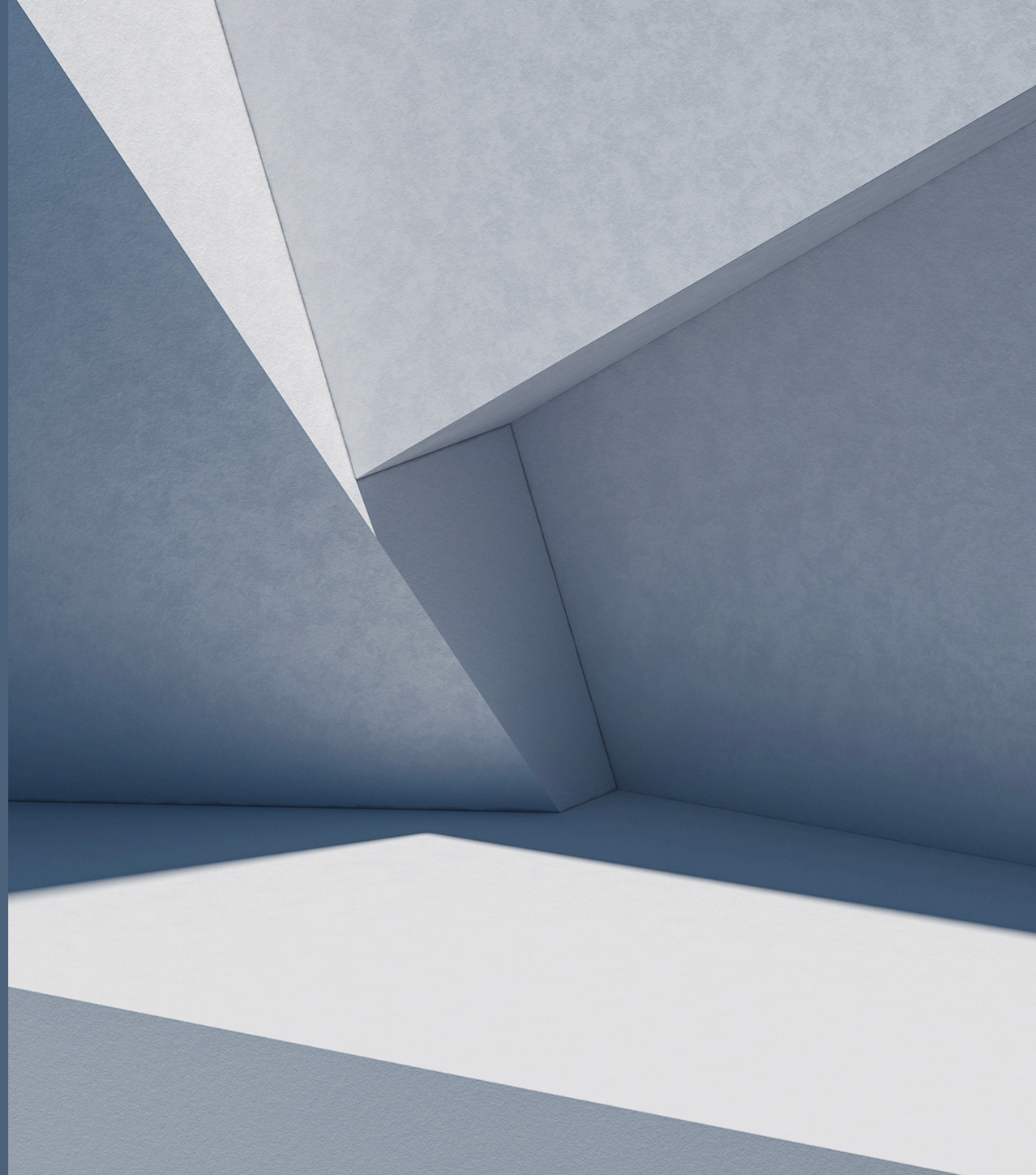
- Can a multi-class CNN model improve the early detection of Alzheimer's disease compared to traditional binary classification models?

- How can deep learning techniques enhance the accuracy and reliability of diagnosing different progression stages of Alzheimer's disease from MRI scans?



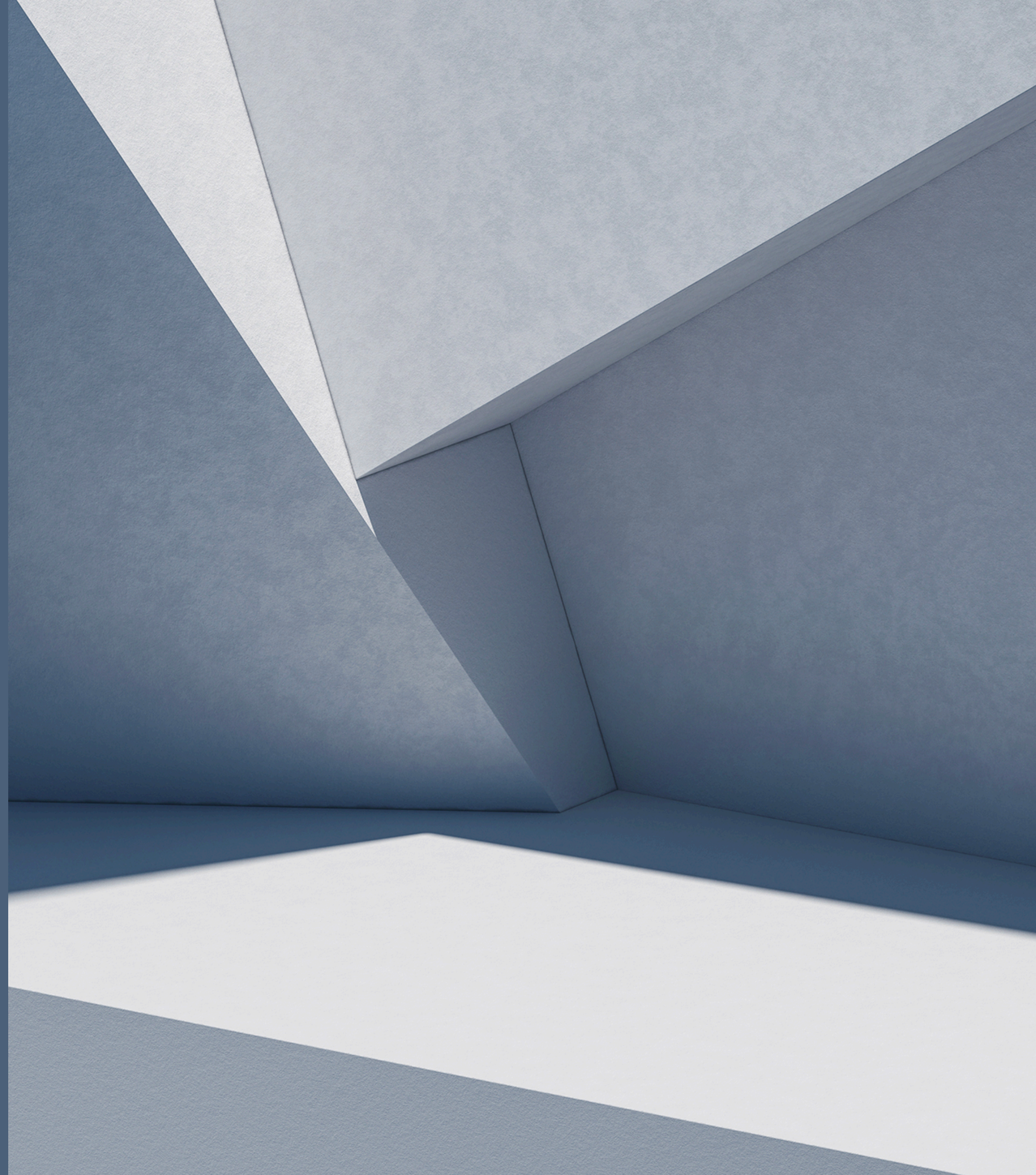
Prior Work

- Deep Learning in Alzheimer's Detection:
  - Previous studies focused on binary classification (demented vs. non-demented).
  - Demonstrated the potential of CNNs in medical imaging.
- OASIS Dataset Utilization:
  - Employed in traditional machine learning for feature extraction.
  - Limited use in multi-class classification tasks.
- 2D vs. 3D Analysis:
  - 2D Slice-Based Analysis:
    - Computationally efficient.
    - Easier to implement with limited resources.
  - 3D Analysis:
    - Provides volumetric data.
    - More computationally intensive.



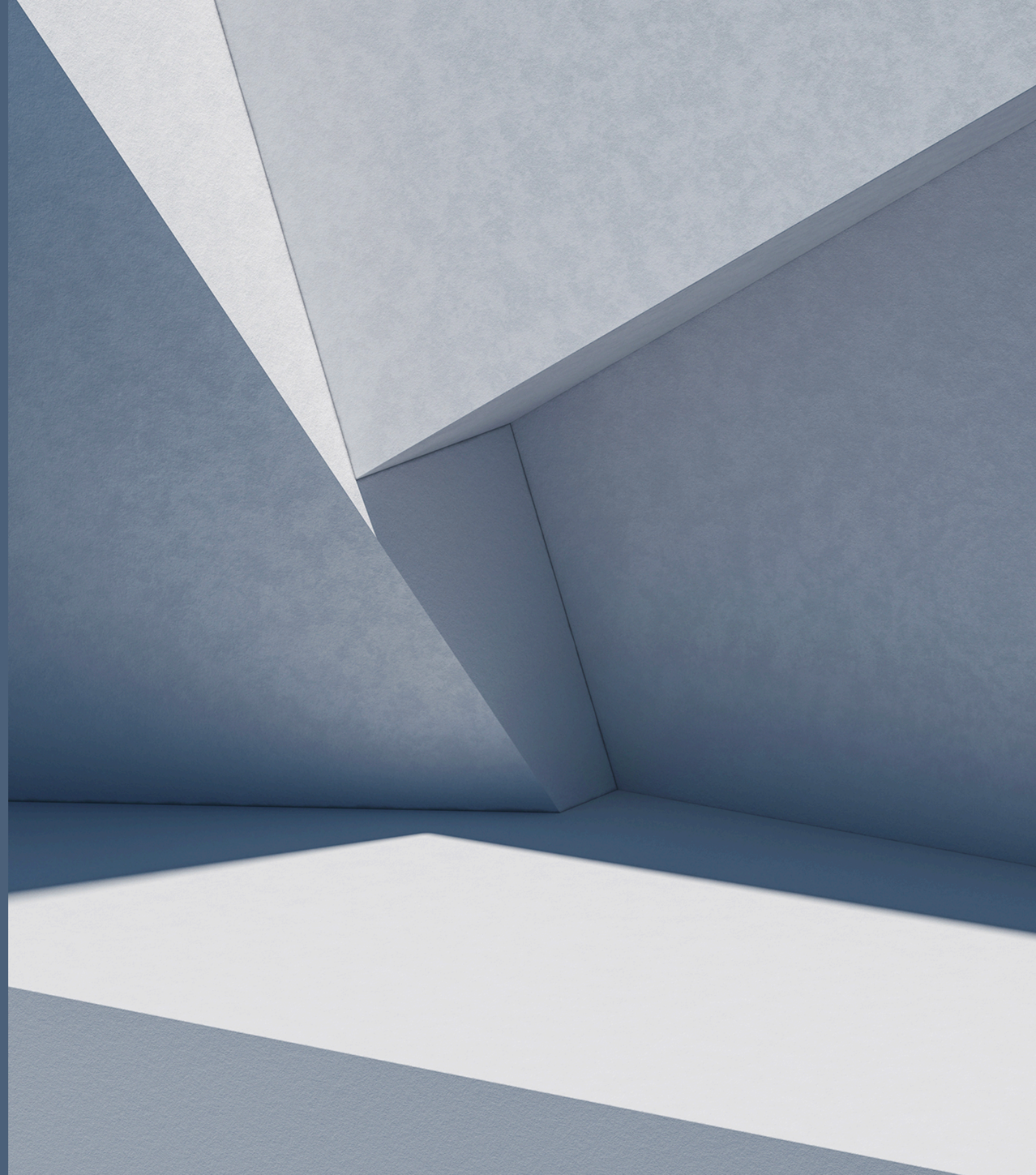
Datasets

- OASIS MRI Dataset: 80,000 MRI images
- Fully downloaded locally, but will utilize cloud resources to run models
- Open Access Series of Imaging Studies (OASIS): Longitudinal MRI Data in Nondemented and Demented Older Adults. Marcus, DS, Fotenos, AF, Csernansky, JG, Morris, JC, Buckner, RL, 2010. Journal of Cognitive Neuroscience, 22, 2677-2684. doi: 10.1162/jocn.2009.21407
- More user friendly access to data found at https://www.kaggle.com/datasets/ninadaithal/imagesoasis/data



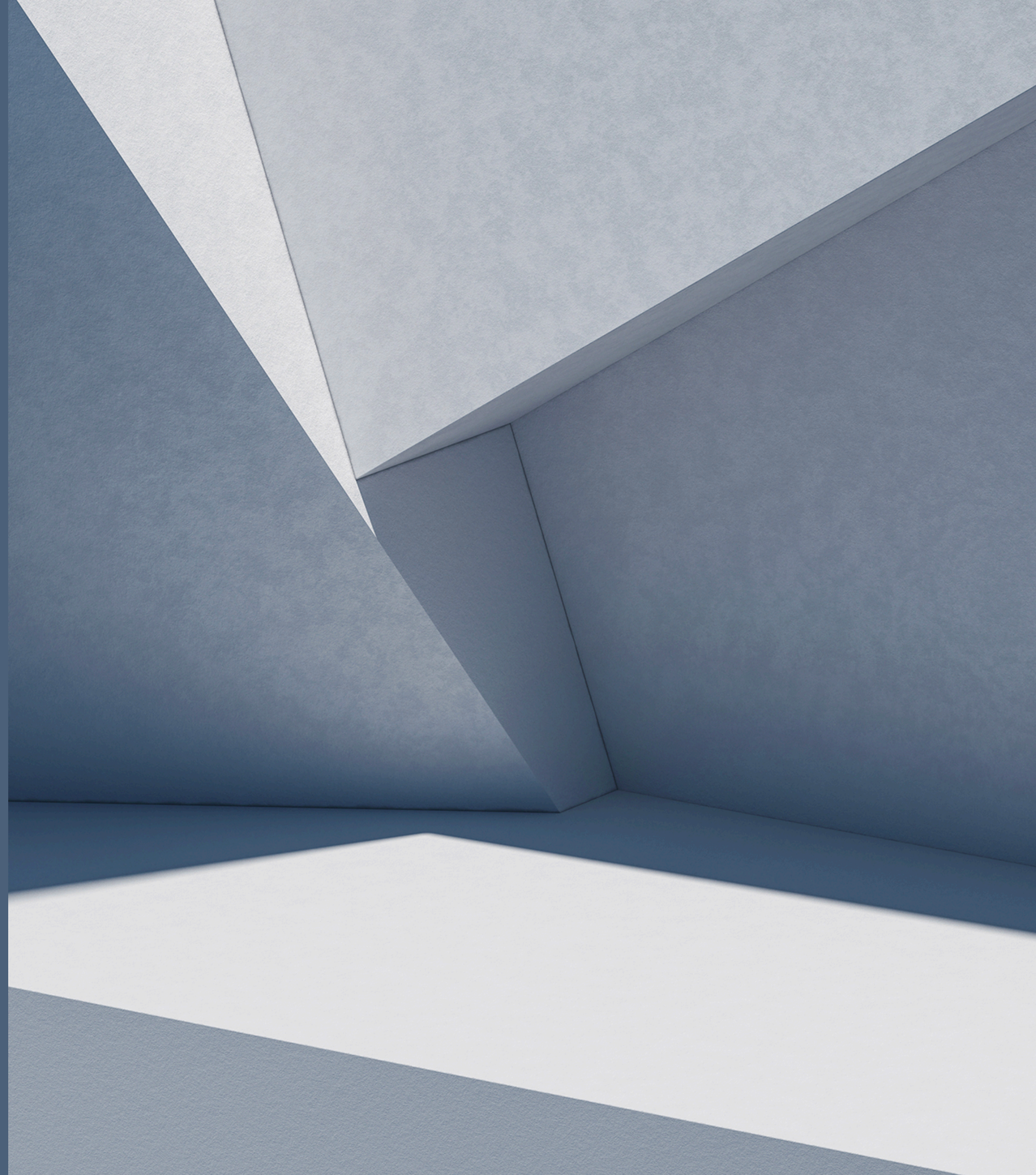
Proposed Work

- Data Cleaning: Handle missing values, class imbalance, and image quality.
- Preprocessing: Normalize, resize (e.g., 224x224), augment data.
- Model Development: Baseline CNN and transfer learning using pre-trained models (e.g., VGG16, ResNet50).
- 3D CNN Exploration: Future possibility.



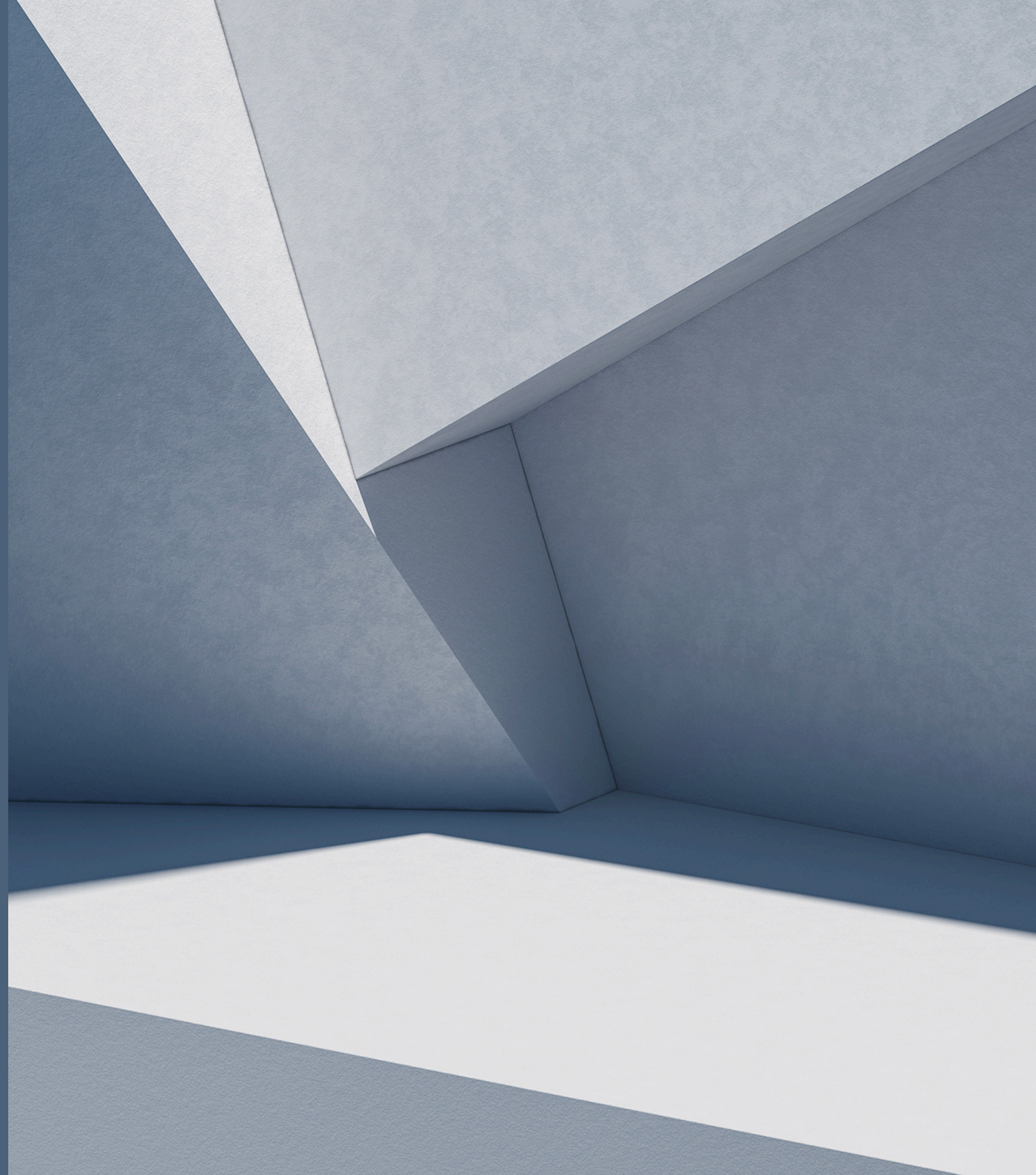
Tools and Libraries

- Programming Language: Python
- Libraries: TensorFlow, Keras, OpenCV, Pandas, Matplotlib
- Development Environment: Jupyter Notebooks, Google Colab (GPU)



Evaluation

- Metrics: Accuracy, Precision, Recall, F1-Score, Confusion Matrix, ROC Curves.
- Error Analysis: Grad-CAM for model interpretability.



Challenges/Mitagation

- Class Imbalance: Augmentation, class weighting.
- Overfitting: Regularization, early stopping.
- Computational Resources: Google Colab, code optimization, batch processing