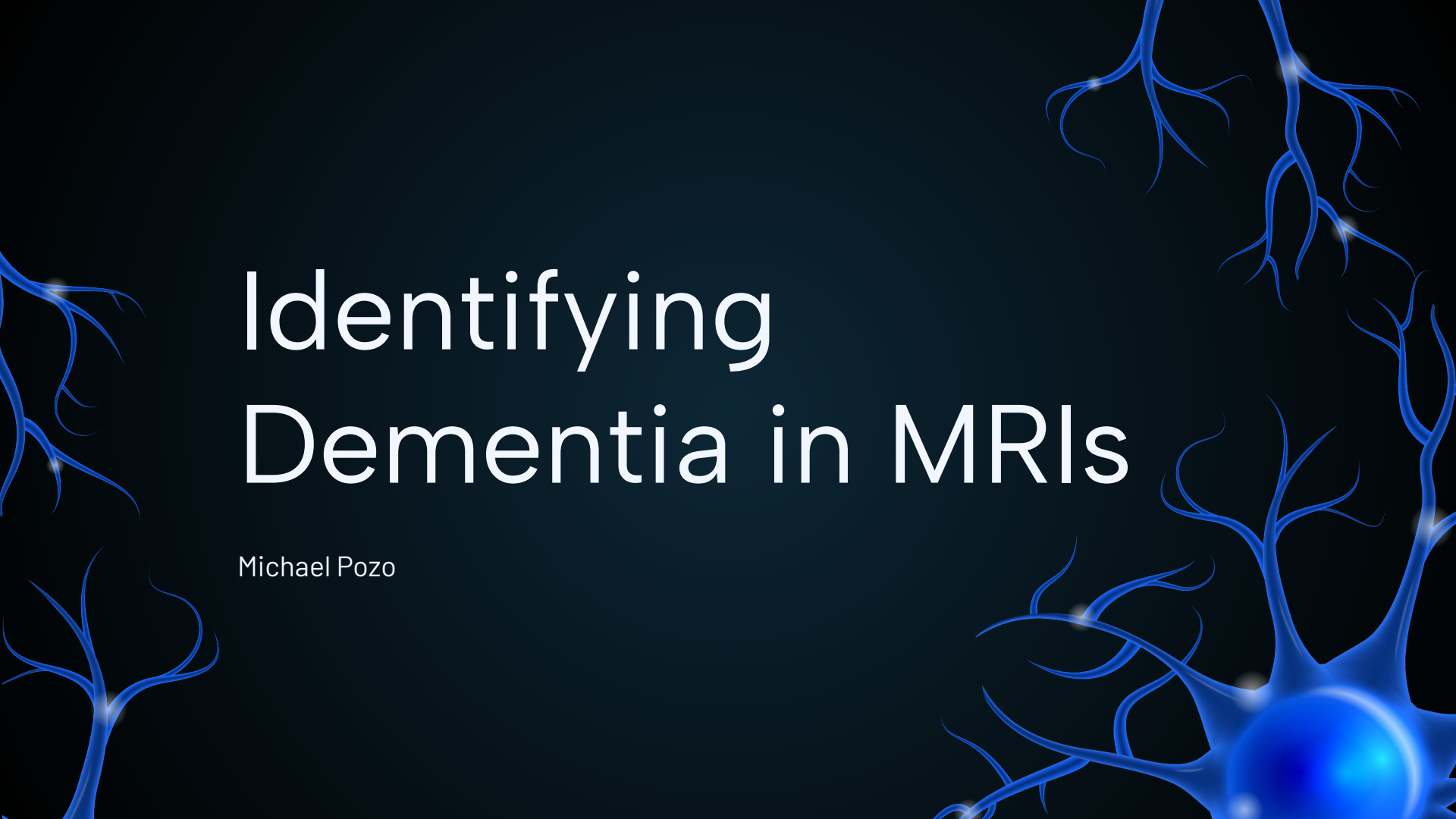


Identifying Dementia in MRIs

Michael Pozo



Today's Agenda

01

Introduction

What is dementia and how is it diagnosed?

02

Data Exploration

RAW vs Preprocessed MRIs

03

Model Results

Accuracy and Loss

04

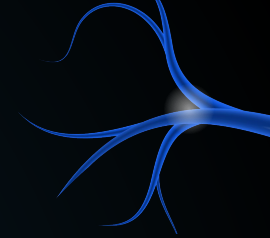
Recommendations

Implementing our models

05

Next Steps

How can we improve in the future?



What is Dementia?

"Dementia is not a specific disease but is rather a general term for the impaired ability to remember, think, or make decisions that interferes with doing everyday activities"

- Center for Disease and Control

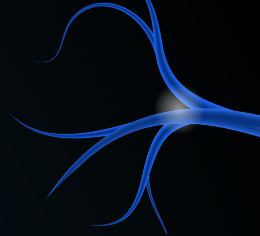
The most common cause of dementia is Alzheimer's Disease, which accounts for up to 80% of dementia cases¹

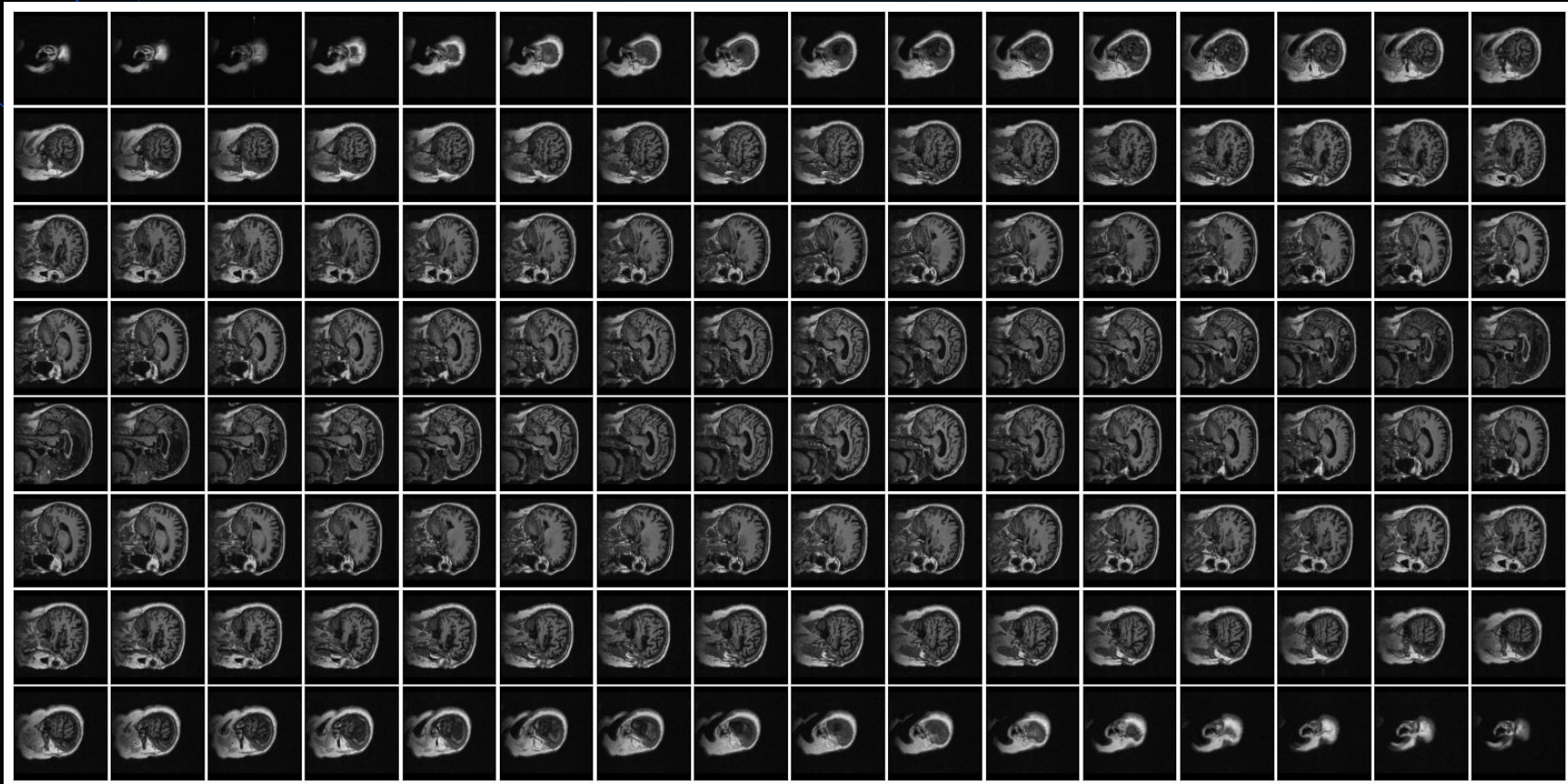
Many tools are used by doctors to diagnose dementia, including the examination of MRIs for signs of atrophy in the brain, yet 18% of early dementia cases are misdiagnosed²

Business Objective: The University of Florida healthcare system is one of the largest care providers for elderly populations in the country. They would like to partner with our team to develop new tools to assist their doctors in diagnosing dementia. Our solution is the use machine learning to build an image classification model that can read and classify MRIs based on the presence of dementia signals

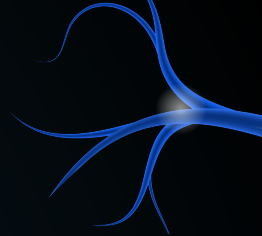
OASIS RAW MRI

- The Open Access Series of Imaging Studies (OASIS) is a project out of the University of Washington aimed at making neuroimaging datasets more freely available³
- The OASIS-2 study consists of longitudinal scans of 150 patients, roughly evenly distributed between dementia and non-dementia patients. Final training sample included 990 scans
- Each scan came in the NIFTI file type which are 3D images containing 128 slices of the brain. The middle cross section from each scan was used in modelling



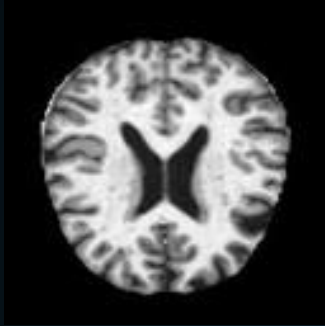


Preprocessed MRI



- To extract the most information out of an MRI, various preprocessing techniques such as brain extraction, segmentation of key architecture, and bias field reduction are often performed
- These techniques allow technicians and doctors to more clearly see abnormalities in the brain and are useful in computer vision as they create clearer structures to examine
- Our preprocessed data comes from the Alzheimer's Disease Preprocessed Dataset on Kaggle, which is sourced from the Alzheimer's Disease Neuroimaging Initiative (ADNI)⁴
- Dataset includes 6,400 MRI scans classified as Non-demented, Very Mildly Demented, Mildly Demented, and Moderately Demented patients

Non-Demented



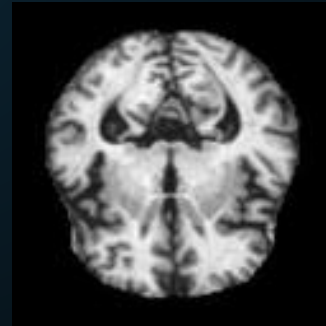
Very Mildly Demented



Mildly Demented



Moderately Demented

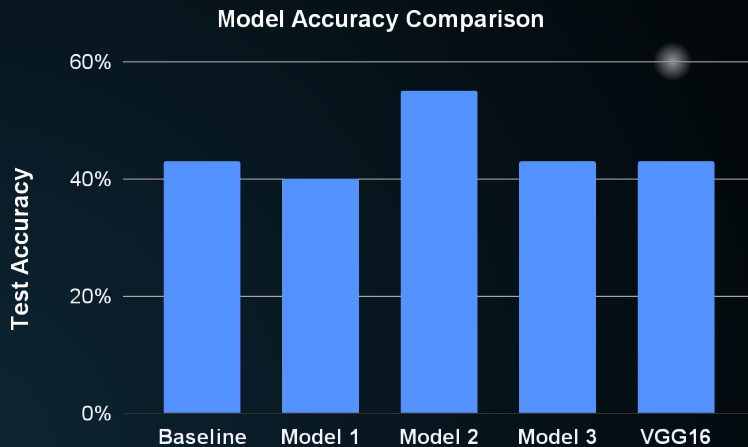


The background of the slide features a dark blue field populated with stylized, glowing blue neurons. These neurons have intricate, branching dendrites and axons. Some neurons are partially visible at the edges, while others are more centrally located. Small, bright white-yellow spots are scattered along the branches, suggesting points of neural activity or synaptic connections. The overall aesthetic is scientific and digital.

Model Performance!!!

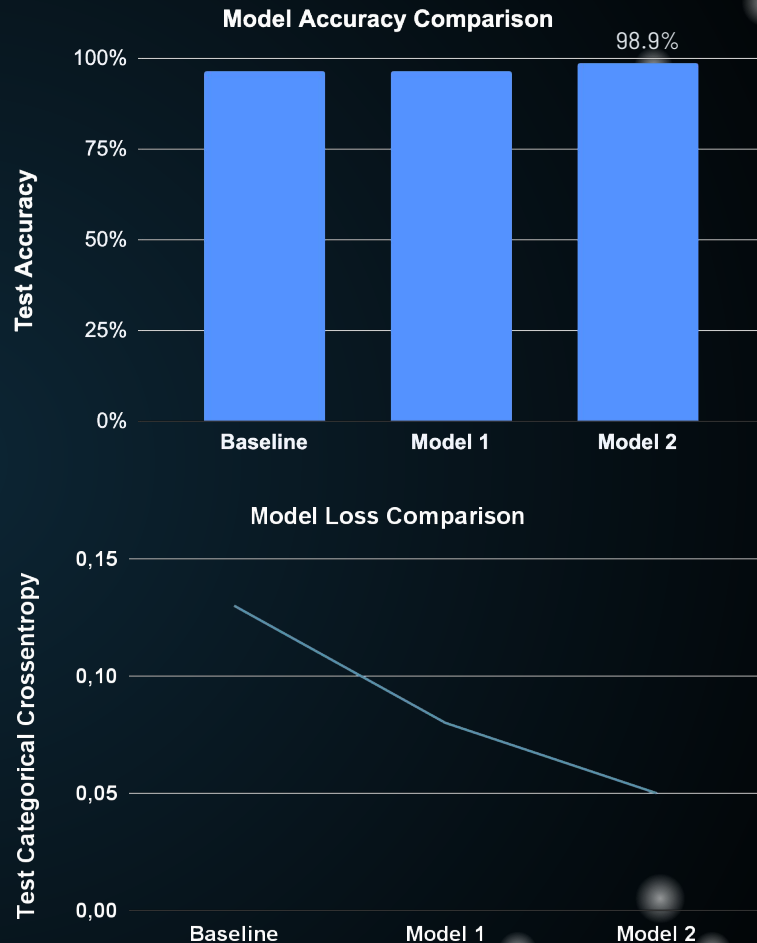
RAW Models

- Modeling techniques applied include gaussian filters, regularization and transfer learning
- Model 2, a simple model architecture with no regularization and a gaussian filter applied performed the best on test data
- Challenges included the lack of distinguishable details in the RAW MRI images and possible loss of quality when slices were transformed into PNG format

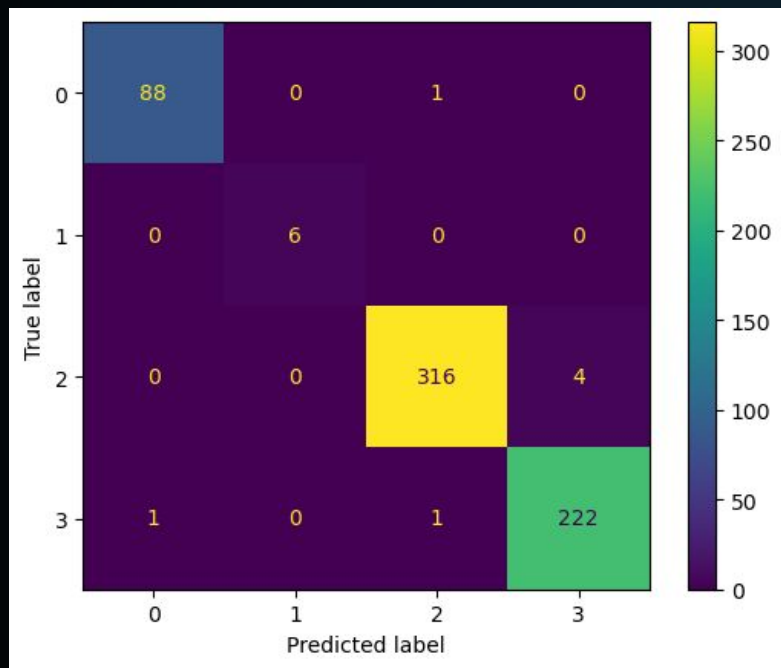
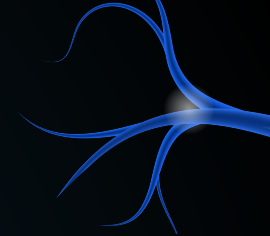


Preprocessed Models

- Same baseline model as the RAW images was able to achieve 96% accuracy
- Fine tuning of the model using dropout and a learning rate schedule allowed the model to maximize performance at 98.9% accuracy and .05 loss
- We attribute the improved performance to the preprocessing creating more distinguishable patterns for the model to pick up on



Early Detection



Class Labels: 0 = Mild Dementia, 1 = Moderate Dementia, 2 = No Dementia, 3 = Very Mild Dementia

- Best model can not only reliably identify dementia, but also distinguish its early stages
- While Alzheimer's disease is not curable, its progress can be slowed down, making early detection very important
- The model shows 98% and 99% precision on mild and very mild cases respectively

Recommendations



Use Computer Vision to Assist Dementia Diagnosis

Our model can identify dementia from preprocessed MRI images with 98.9% accuracy, including early stages. Doctors can use this as another tool to assist in diagnosis and hopefully improve early detection



Preprocess Images

Preprocessed images perform significantly better than RAW MRI images in identifying dementia. If not already in place, we would recommend creating a preprocessing pipeline to allow images to feed directly into the model

Next Steps

1

Enhance RAW Images

Possible quality loss in
converting NIFTI slices to PNGs
for modeling

2

Use 3D

Attempts to use full 3D RAW
images were limited by memory
constraints.

3

Expand Data Set

RAW images limited to 1,000
scans. May see improvement
with larger samples

The background of the slide features a dark blue gradient with several stylized, glowing blue neurons. These neurons have a central cell body and multiple branching processes, some of which are highlighted with bright blue light effects. The neurons are positioned in the corners and along the edges of the frame, creating a sense of depth and complexity.

Questions??

The Analyst



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- **Location:** New York, NY
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- **Employer:** Free Agent
- **Allergies:** None

01

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03

Github

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- 1.) <https://www.cdc.gov/aging/dementia/index.html>
- 2.) <https://www.mdedge.com/neurology/article/77927/alzheimers-cognition/misdiagnosis-alzheimers-disease-linked-less-severe>
- 3.) <http://www.oasis-brains.org/>
- 4.) <https://www.kaggle.com/datasets/sachinkumar413/alzheimer-mri-dataset>

