

Project 1

1002222442 Minheng Chen

This project involves developing a Convolutional Neural Network (CNN) for binary classification using provided MRI data to distinguish between Alzheimer's Disease (AD) patients and healthy people (CN).

Model Architecture

The CNN model consists of two 3D convolutional layers followed by max-pooling, and two fully connected layers. It accepts 3D MRI volumes and outputs a classification into two categories: health or patient.

In detail, the architecture of the CNN which is adopted in this project is as follows:

- Conv Layer 1: 16 filters, kernel size 3x3x3, followed by ReLU and max pooling.
- Conv Layer 2: 32 filters, kernel size 3x3x3, followed by ReLU and max pooling.
- FC Layer 1: Fully connected layer with 128 units.
- FC Layer 2: Fully connected layer with 2 output units (health or patient).

It has four layers in total, the first two layers are convolutional layers, and the last two layers are fully connected layers. The final output is a two-dimensional vector, corresponding to the probabilities of NC and AD (NC is 0 and AD is 1), and we choose the larger value as the prediction result. And the loss function in this project is cross-entropy loss.

Implementation Details

For network training, we used the Adam optimizer, set the learning rate to $10e-4$, and trained for ten epochs. For the input MRI volume, we normalized it to between 0 and 1 before passing it into the network. Figure 1 shows the change of the loss function during training. If necessary, *you can reproduce and run the code according to the instructions in the readme file.*

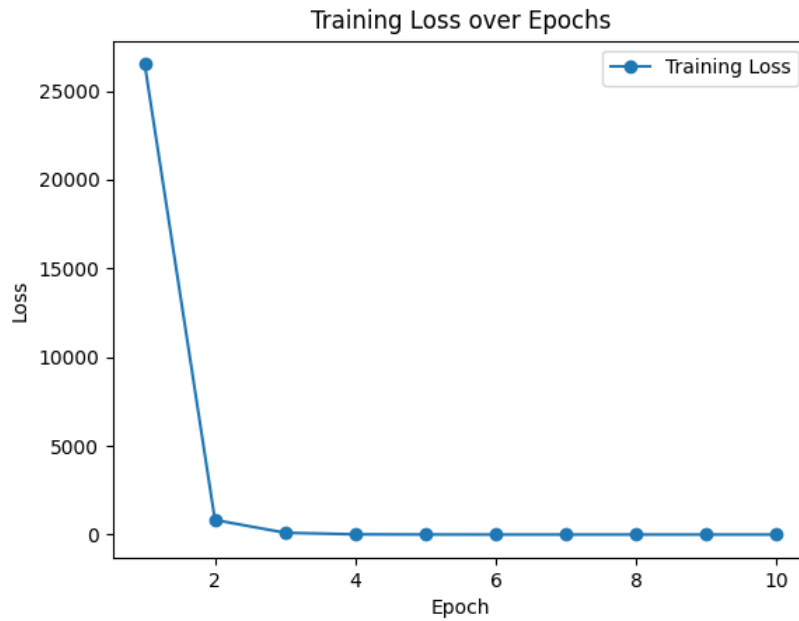


Figure 1 Training loss over 10 epochs.

Experiment

This project provides a total of 20 MRI volumes for experiments, 10 of which are used as training sets and 10 as test sets. Each set contains 5 NC and 5 AD individuals. We report the classification accuracy and its corresponding confusion matrix.

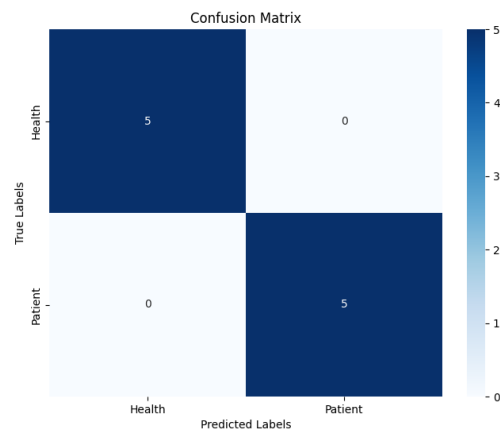


Figure 2 Confusion matrix of AD classification

As shown in Figure 2, the simple network achieved **100%** classification accuracy on this task. We provide a visualization of the test set and their corresponding prediction results and labels in Figure 3.

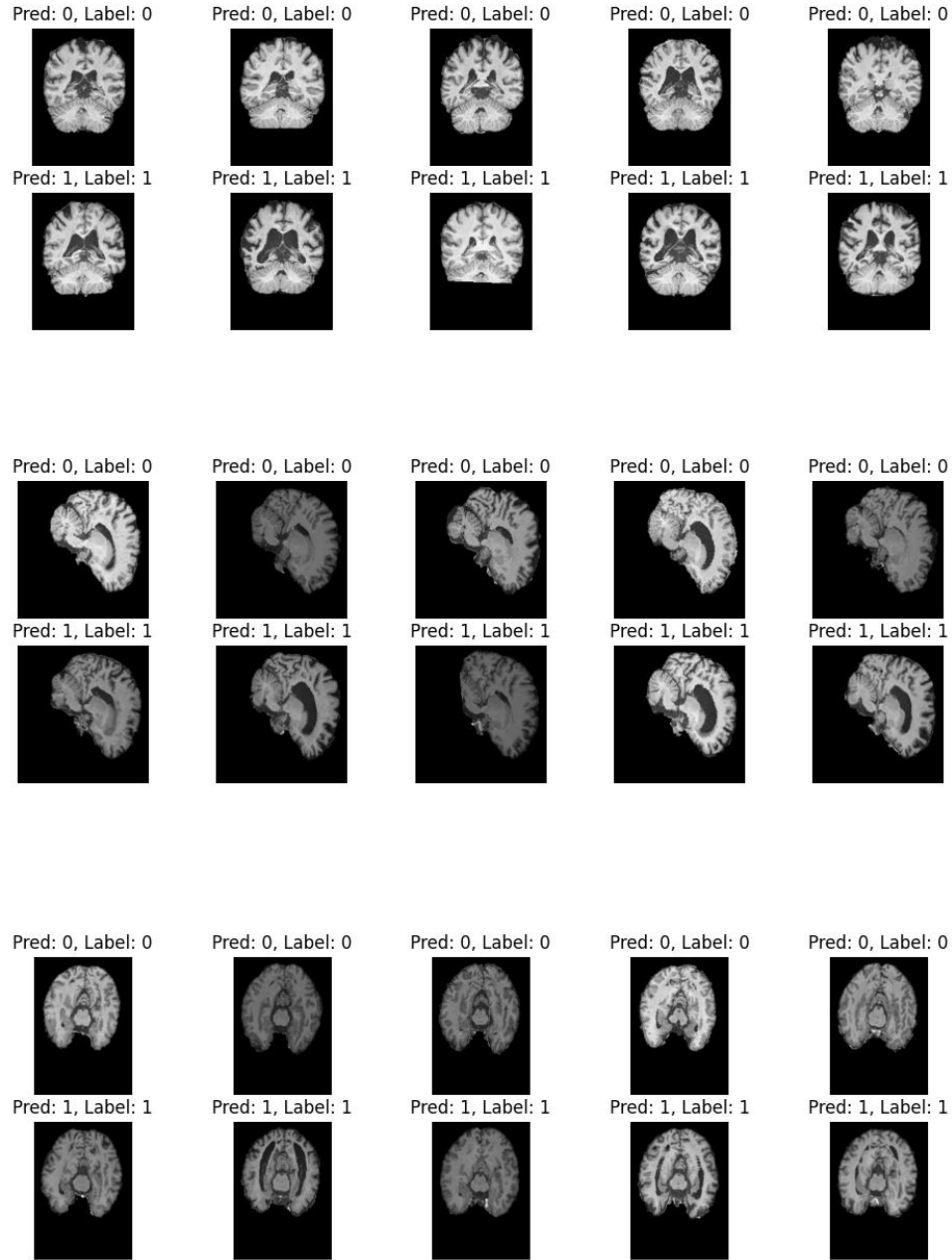


Figure 3 Visualization of the test dataset.

Conclusion

In this project, a 3D Convolutional Neural Network (CNN) was successfully developed and implemented to classify MRI volumes into two categories: Alzheimer's Disease (AD) patients and

healthy individuals (CN). The results suggest that this CNN model is highly effective in distinguishing between AD and CN individuals in this specific dataset. However, further validation on larger and more diverse datasets would be necessary to confirm the model's robustness and generalization capability.