A Novel Approach for Early Detection of Alzheimer's Disease: Developing an AlexNet Convolutional Neural Network Enhanced by Class Activation Mapping

Xu, William (School: Bangor High School)

Alzheimer's disease (AD) is a chronic, neurodegenerative illness characterized by forgetfulness, cognitive impairment, and the progressive loss of a variety of other brain functions as well as daily life independence. By 2050, the existing 47 million AD sufferers are predicted to grow to 152 million, with major economic, medical, and societal implications. The pathophysiology of Alzheimer's disease is still unknown, and there is no cure or treatment that can stop the illness from progressing altogether. Alzheimer's disease must be detected early in order to be effectively managed. An emerging detection methodology includes deep learning approaches that have demonstrated promising results; nonetheless, effective implementations in real-world settings must combine high accuracy, quick processing time, and scalability for a variety of demographics or populations. I developed an AlexNet convolutional neural network (CNN) based classification model using magnetic resonance imaging (MRI) images available from the Alzheimer's Disease Neuroimaging Initiative (ADNI). This AlexNet model was then applied to the ADNI dataset to classify four different stages of AD. I then tested my model on test datasets to evaluate the accuracy of the model per stage: 95.5% for early dementia, 95.1% for moderate dementia, 89.3% for no dementia, and 92.7% for late dementia. In the visualization results, the ventricles and outer regions were identified as key regions for classification. These CNN recognition results were further accurately interpreted with the newly developed class activation mapping (CAM), allowing for the interpretability of given diagnoses.

Awards Won: