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3D Convolutional Neural Networks for the diagnosis of 6 unique pathologies on head CT

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Introduction: Head CT scans are a standard first-line tool used by physicians in the diagnosis of neurological pathologies. Recently, the development of deep learning models such as convolutional neural networks (CNNs) has allowed the rapid identification of bleeds and other pathologies on CT scans. This study aims to show that by training 3D CNNs with a larger, curated dataset, a more comprehensive list of potential diagnoses can be included in the detailed model.

Methods: A retrospective study was performed using a dataset of 66,000 head CT studies from the Thomas Jefferson University health system. Studies were acquired using a natural language processor that searched for 60 different diagnoses, and the scans were then grouped into six distinct classes. Images were preprocessed by converting CT Hounsfield Units to greyscale, cropping to remove negative area, normalizing pixel values, and resizing to fit the input dimensions of the neural network. To automatically classify the studies, a three-dimensional residual neural network (3D-ResNet), was trained using 80% of the dataset as a training set and 20% of the dataset as a test set.

Results: To achieve the most accurate results, a 3D-ResNet with 34 residual layers was used. Following the training of the 3D-RESNET, the model achieved an accuracy of 0.47 on the test set and 0.915 on the training set.

Discussion: These results show a promising initial step toward machine-assisted diagnosis of head CT scans. As more potential diagnoses are added to models, the

utility of the models increases, and more studies can be quickly processed. Going forward, neural networks could potentially be used to prioritize radiology worklists and perform automatic diagnosis of urgent scans.