Analyzing the Effects of Non-Generative Augmentation on MRI-Based Classification of Brain Tumors Using Convolutional Neural Networks

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Due to the devastating effects that brain tumors have on the body, early classification is crucial in reducing cancer mortality, improving quality of life, and developing a treatment plan. Although biopsies are often used for diagnosis, brain tumors can be classified using techniques like MRI, a process that can be automated. In this study, I developed a Convolutional Neural Network (CNN) model to classify four classes of brain tumors – gliomas, meningiomas, pituitary tumors, and no tumors. I then observed how different methods of data augmentation affected my model's capabilities when used individually and in combination with each other. Data augmentation plays a crucial role in classification tasks as it diversifies a dataset and helps prevent overfitting, which can increase a model's accuracy. This study sought to discover which method of augmentation was most effective at doing so. I tested several of the most commonly used methods of augmentation, including horizontal and vertical translations, reflections, rotations, and zooming, in different combinations over six trials. In doing so, I found that the model using no augmentation obtained a classification accuracy of 93.02%. The most successful trial, however, utilized random horizontal and vertical translations, which resulted in a classification accuracy of 95.80%. These results demonstrate the efficacy of augmentation in improving CNN models and show that translations were most successful at improving my model. Further research should seek to optimize the parameters of the augmentation methods I used, as well as continue to test the efficacy of augmentation on different datasets.

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