A Novel Convolutional Neural Network to Detect and Classify Brain Tumors

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Brain tumors represent a critical health challenge, affecting thousands of individuals annually and often leading to significant harm and mortality. Such challenges highlight the need for innovative solutions to enhance diagnostic precision and reduce delays in determining the correct treatment. This project designed and developed a novel Convolutional Neural Network (CNN) to improve brain tumor classification accuracy while minimizing false positives. Unlike commercial plugin software such as ResNet, this neural network was completely custom-made in order to be specified for the project, thus optimizing accuracy and reducing loss. The CNN was programmed in Python using TensorFlow and Keras libraries in Google Collaboratory, and custom convolutional, dropout, and batch normalization layers were integrated to enhance feature learning and prevent overfitting. The model was trained and tested on an open-source, publicly available, and de-identified dataset of brain MRI scans, consisting of 5711 scans for training and 1311 for testing (80:20 ratio). The CNN achieved a 97.02% testing accuracy after the 25th epoch, with a steady increase in accuracy through epochs. More epochs will most likely result in extremely high accuracy, with the potential to get over 98%. The false-positive rate was only 5/1311 tests. The CNN outperformed the statistics of purely human detection and classification methods by providing rapid, non-invasive, and highly accurate brain tumor detection. Additionally, this AI model was saved, and a custom backend and frontend were programmed in a multitude of languages (JavaScript, HTML, CSS, and Python) to create a web app, entitled Nuro, with login encryption and treatment plans directly from an API search of the National Cancer Institute.

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