GliomAssist: Computational Glioma Grading and Prognosis With PET

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Aims: The purpose of this study was to use machine learning algorithms to build an effective, non-invasive and automated pipeline for grading and characterizing gliomas according to WHO 2016 classification. Material and Methods: C11-PET scans of WHO II, III and IV grades were acquired from dataset of patients visiting NIMHANS, Bengaluru. Through computational texture extraction, we extracted first-order, second-order and third-order features, tabulating 61 features totally. Normalizing the data, we developed a baseline prediction algorithm, which confirmed that our data was classifiable. Following this, we developed Linear SVC, Gradient Boosting and Random Forest frameworks, and conducted a hyperparameter search for each of these classifiers to determine the ambient set of parameters for satisfactory functioning of the model. Results: In terms of ROC-AUC and accuracy, Gradient Boosting Classifier had the best performance (AUC = 0.94; Accuracy = 98.44%), compared to Random Forest (AUC = 0.81; Accuracy = 88.7%) and Linear SVC (AUC = 0.56; Accuracy = 52.1%). Furthermore, we found that RLM gray level non-uniformity was most indicative of a high-grade tumor (p = 0.041), while CBV was found to be least indicative (p = 0.996). However, when distinguishing between Grade II and III, all classifiers performed relatively poorly; even still, Gradient Boosting Classifier had the highest scores (ROC = 0.74, accuracy = 73.6%). Conclusion: It is clear that method of grading using Gradient Boosting Classifier is highly accurate, particularly in distinguishing Grade IV from Grade II and III gliomas. Furthermore, its non-invasive and quantitative nature erases cross-specialist subjectivity and qualitative judgements inherent in histopathological examinations.

Awards Won:

Third Award of $1,000