"Weakly Supervised Segmentation of Brain Tumors Using Attention-Based Deep Learning"

Abstract:
We propose a weakly supervised deep learning approach for segmenting brain tumors in MRI scans using coarse annotations. Leveraging attention mechanisms and a hybrid loss function, the model learns to highlight tumor regions despite the absence of pixel-level labels. This method reduces annotation burden while maintaining competitive accuracy.

Introduction:
Accurate tumor segmentation is critical for planning treatment in brain tumor cases. However, fully annotated datasets are labor-intensive to produce. Weak supervision offers a scalable alternative using image-level or bounding box labels.

Methods:
A dataset of 50 T2-weighted MRIs with bounding box tumor labels was used. The model architecture combined a ResNet encoder with a U-Net-like decoder and self-attention layers to infer spatial localization. Training used a composite loss function mixing classification and region-based consistency terms.

Results:
On a test set of 10 fully annotated scans, the model achieved a Dice score of 0.73. Visual inspection confirmed plausible delineation of tumor margins, especially for large and mid-sized masses.

Discussion:
This work shows that even with coarse labels, attention-based networks can learn effective tumor localization. This supports wider deployment in resource-limited settings, where expert annotations are scarce.