AD-Stage-Net: AI for Alzheimer's MRI Classification

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Alzheimer's disease (AD) is the most common neurodegenerative disorder and a leading cause of dementia worldwide, making early and accurate staging critical for research and care planning. AD-Stage-Net is a deep learning system developed to classify brain MRI scans into four stages: No AD, Very Mild, Mild, and Moderate. A major challenge in medical artificial intelligence is model generalization, in which models perform well on training data but struggle when applied to new datasets. To address this, models were trained on one publicly available MRI dataset (Luke) and evaluated on three independent datasets (Marco, Falah, and OASIS-1) to measure cross-dataset robustness and domain shift. Multiple convolutional neural network architectures were compared, including ResNet, DenseNet, and EfficientNet variants. Images were standardized through resizing and normalization, and all models were trained using consistent optimization procedures to ensure fairness and reproducibility. In addition to individual models, late-fusion ensemble approaches were implemented to combine predictions from top-performing networks and improve stability across datasets. The best-performing ensemble, integrating ResNet50 and DenseNet161, achieved an average accuracy of 98.71% across primary evaluation datasets and maintained strong consistency under external testing conditions, including OASIS-1. To promote transparency and accessibility, the final models were deployed to a public web platform where users can upload MRI images and receive real-time stage predictions for research purposes. AD-Stage-Net demonstrates how cross-dataset validation and ensemble modeling can improve robustness and reliability in multi-stage Alzheimer's MRI classification.

Awards Won: