UNIVERSIDADE CATÓLICA PORTUGUESA
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3º year bachelor's degree in data science – Deep Learning

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Brain Tumor Detection Using Neural Networks on MRI Images

BRAGA

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Introduction

Motivation

- Early detection of brain tumors is crucial for improving patient outcomes, but manual interpretation of **Magnetic Resonance Imaging** *(MRI)* scans is a challenging and time-consuming task. This project addresses this issue by designing and training Convolutional neural networks *(CNNs)* from scratch to classify MRI images into tumor and non-tumor categories. The approach focuses on developing custom architectures adapted to the dataset, enabling a more in-depth exploration of model performance and feature extraction compared to pre-trained models.
- Train models from scratch not only allow for greater flexibility in architecture design but also provide valuable insights into the dataset characteristics and challenges. By employing a rigorous experimental methodology and leveraging data augmentation to mitigate overfitting, the project aims to achieve a robust and efficient tumor detection system.

Related Works

1. Enhancing Brain Tumor Detection Through Custom Convolutional Neural Networks and Interpretability-Driven Analysis

- This paper introduces a custom CNN designed for brain tumor detection, addressing challenges like class imbalance and interpretability. The proposed model achieved high accuracy and used gradient-based saliency maps for explainability.

2. Developments in Brain Tumor Segmentation Using MRI: Deep Learning Insights and Future Perspectives

- This paper explores the advancements in brain tumor segmentations using **MRI.** It focuses on the application of **deep learning** techniques, especially **CNNs**. The paper discusses challenges, including variability in tumor shapes and sizes, and presents future perspectives on improving segmentation accuracy using advanced methods like **GANs** *(Generative Adversarial Networks)* and **multi-modal** MRI data integration.

3. Tumor Diagnosis against Other Brain Diseases Using T2 MRI Brain Images and CNN Binary Classifier and DWT

- This paper focuses on using **T2-weight MRI Images** to distinguish brain tumors from other brain diseases. It leverages a **CNN** for binary classification and incorporates **Discrete Wavelet Transform** *(DWT)* to extract features from MRI images. This combination aims to improve diagnostic accuracy by enhancing image analysis and distinguishing between tumor and non-tumor conditions in the brain.

4. Data Augmentation for Brain-Tumor Segmentation

- This paper explores **data augmentation** techniques specific to brain tumor detection, including MRI techniques such as rotations, translations, cropping, and pixel intensity augmentations. The study also discusses the most effective and recent data augmentation approaches applied to the context of brain tumors, as well as more advanced techniques such as the use of Generative Adversarial Networks *(GANs)* to create synthetic images that help improve the performance of deep learning models.

References

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