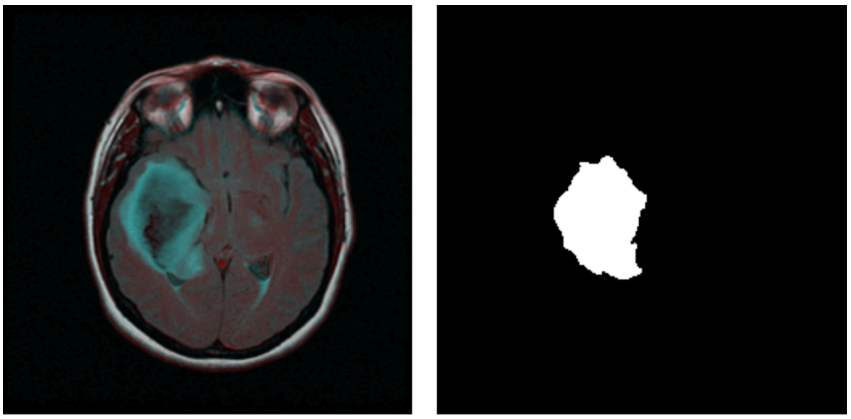
Brain MRI Segmentation

University of Tehran
Department of Computer Science
Artificial Intelligence



Project Description

This project involves the application of image segmentation techniques to identify and delineate cancer tissues from brain MRI images. Students will work with the LGG Segmentation Dataset, which contains brain MRI images from 110 patients. You're provided with an article to compare your results with.

In evaluating your project, we will consider both the performance metrics you achieve and the sophistication of your approach and models. We encourage you to explore various models, techniques, and methodologies in order to deepen your understanding and showcase your expertise. Remember, the goal is not just to obtain good results using baseline or basic models, but rather to demonstrate your understanding of the underlying principles and apply more advanced techniques where appropriate.

Dataset

- **Name**: LGG Segmentation Dataset
- **Size**: 749 MB
- **Content**: 3929 brain MRI images with corresponding ground truth masks
- **Format**: tif images
- **Availability**: Open-access for research and educational purposes

Project Phases

1. **Dataset Familiarization**
    - Explore the dataset
    - Understand the structure of images and corresponding masks
    - Display 10 images and their corresponding masks
2. **Preprocessing**
    - Implement image preprocessing techniques (e.g., resizing, normalization)
    - Split the data set into train, validation, and test sets (80-10-10)
    - Display 10 images and their corresponding masks after preprocessing

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3. **Implementation, Training, and Validation of the Model**
   - Implement a U-Net model using the main article that introduced this architecture
   - Choose proper hyperparameters that work best for your model (e.g., batch size, epochs)
   - Train and Validate the model on the dataset
   - Report and plot the performance metrics during training and validation phases (e.g., loss, accuracy, IoU, Dice Coefficient, etc., depending on the task).
4. **Results and Analysis**
   - Analyze the performance of the model
   - Discuss any challenges faced during training and how they were overcome
   - Compare the model's performance with that of the provided paper
   - Display 10 test images, ground truths, and their corresponding generated masks
5. **Documentation and Reporting**
   - Document the entire project on a PDF file and a Jupyter notebook, including the steps taken, methods used, and code implementation.

Suggestions

Use Kaggle and its GPUs to access the dataset directly. This will make the workflow faster and easier by avoiding the need to download the dataset. Also, document your code clearly for better understanding and reproducibility.

Bonus: As a bonus challenge, you are encouraged to explore and implement variations of the U-Net architecture to enhance the performance of brain MRI segmentation.