Brain Tumor Segmentation Based on MRI Images

Imaging for the Life Science

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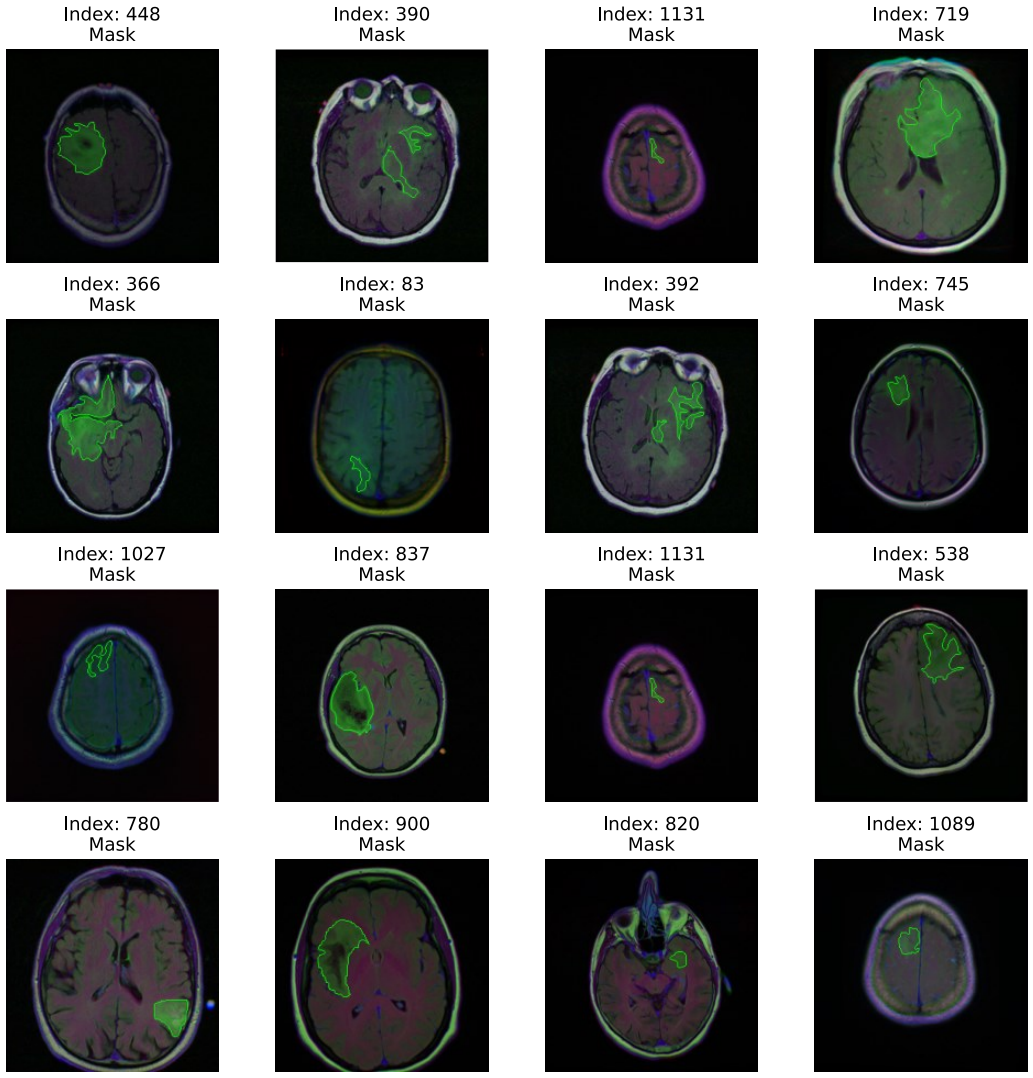
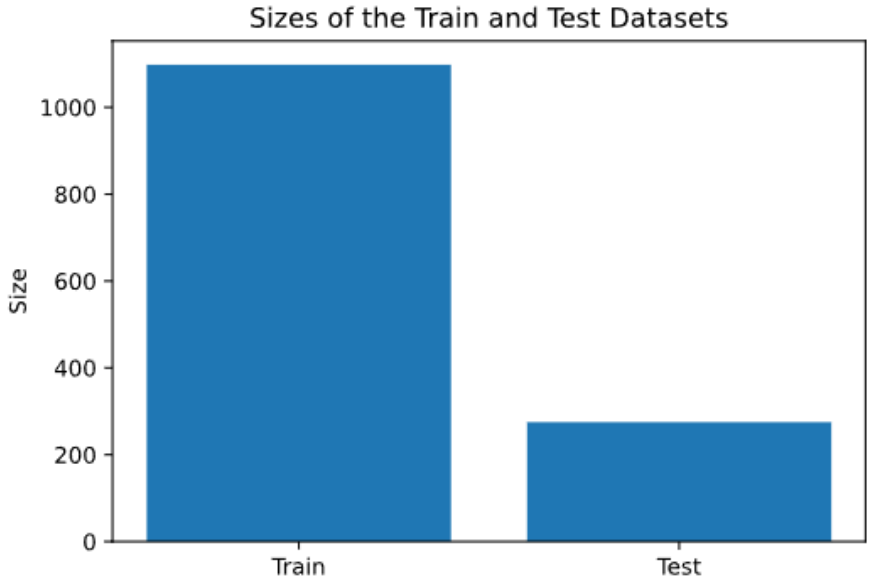
Introduction

- **Prevalence of Brain Tumors**
  - Approximately 11,700 new brain tumor diagnoses occur annually in the U.S.
  - The 5-year survival rate for brain tumor patients is around 35%.
- **Importance of Timely and Accurate Diagnosis**
  - Early and precise diagnosis can significantly improve treatment planning and outcome predictions.
- **Current Diagnostic Techniques**
  - Magnetic Resonance Imaging (MRI) is the primary method for diagnosing brain tumors.
  - MRI scans generate a vast amount of image data, posing significant challenges in analysis due to the complexity of the images and the extensive time required for manual examination by experts.
- **Advancements in Image Analysis**
  - Recent years have seen the application of deep learning techniques to enhance the analysis of MRI images, aiming to overcome limitations associated with human error and the intensive labor of manual analysis.
- **Project Focus**
  - This project develops and utilizes a deep learning-based model to segment brain tumor images, aiming to provide more accurate, efficient, and consistent diagnostic results.

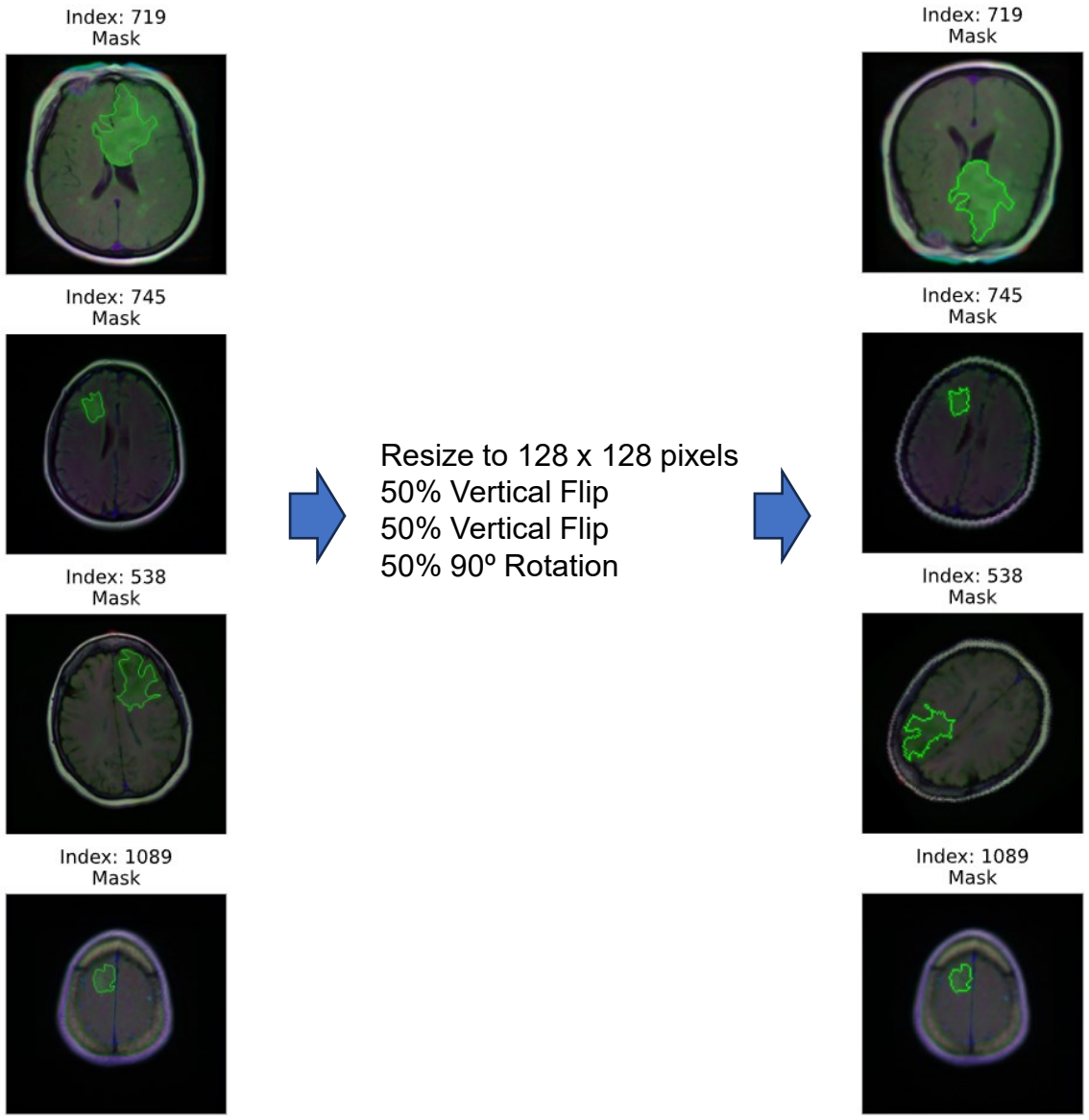
Dataset



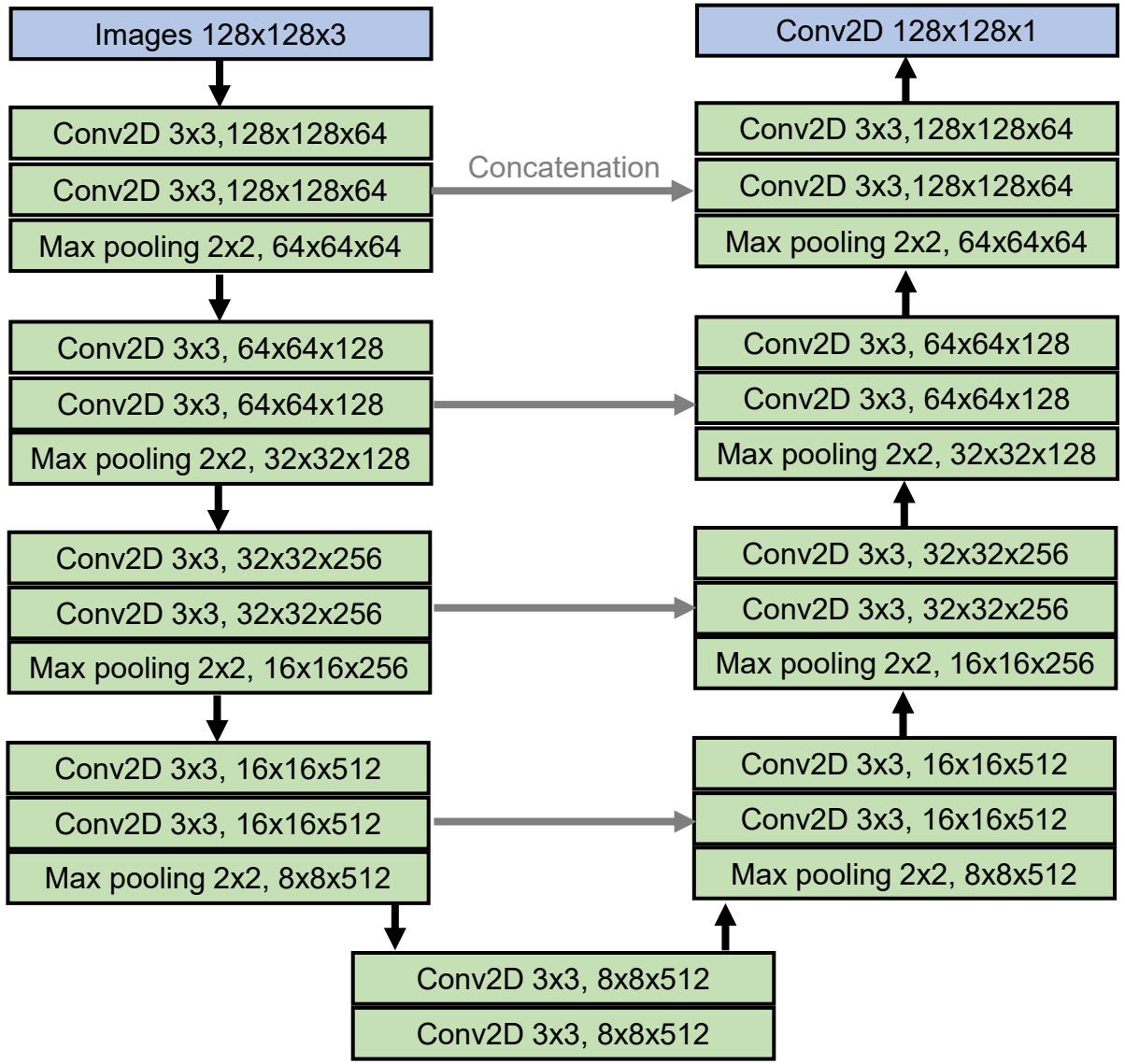


Data source: https://www.kaggle.com/datasets/mateuszbuda/lgg-mri-segmentation

Image augmentation

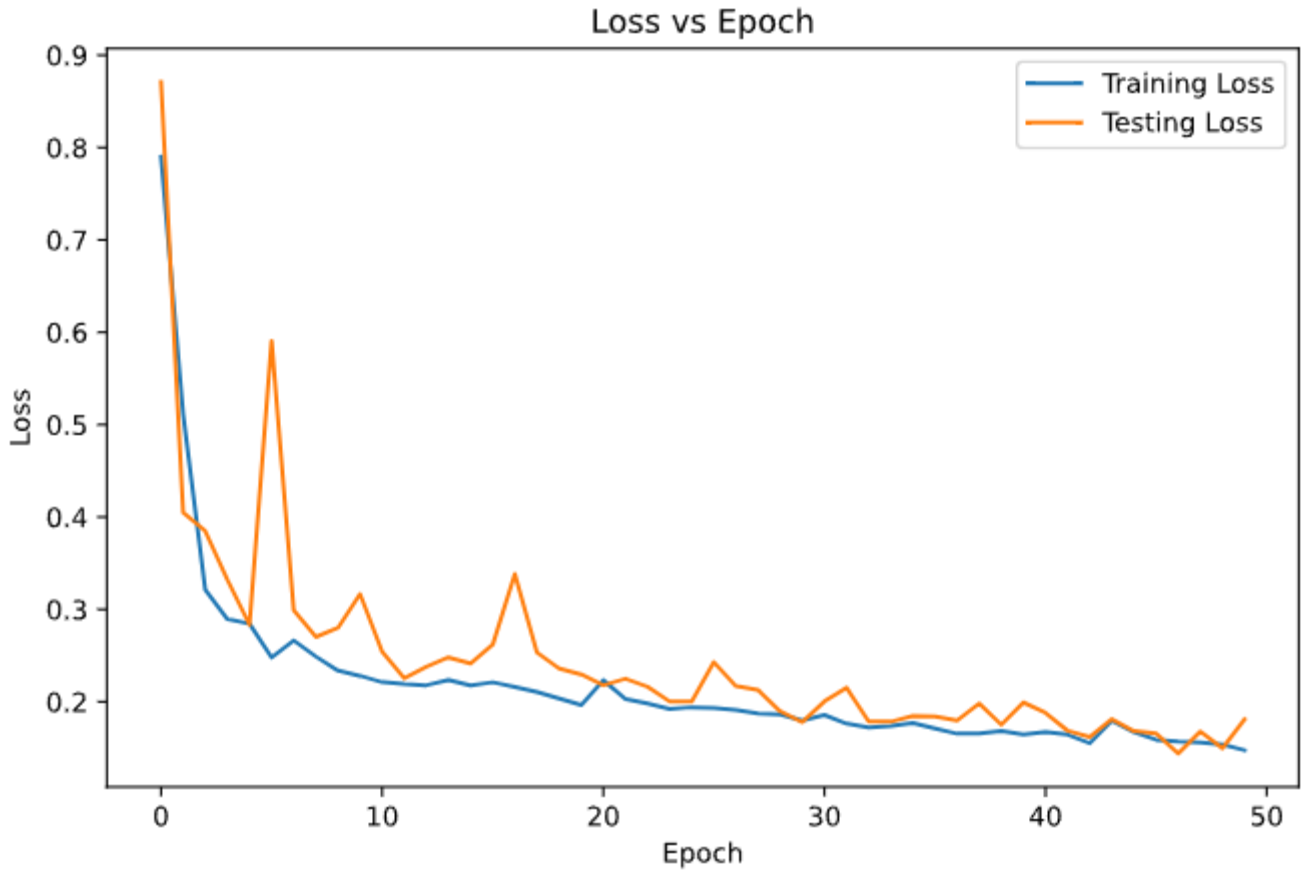


Training Models

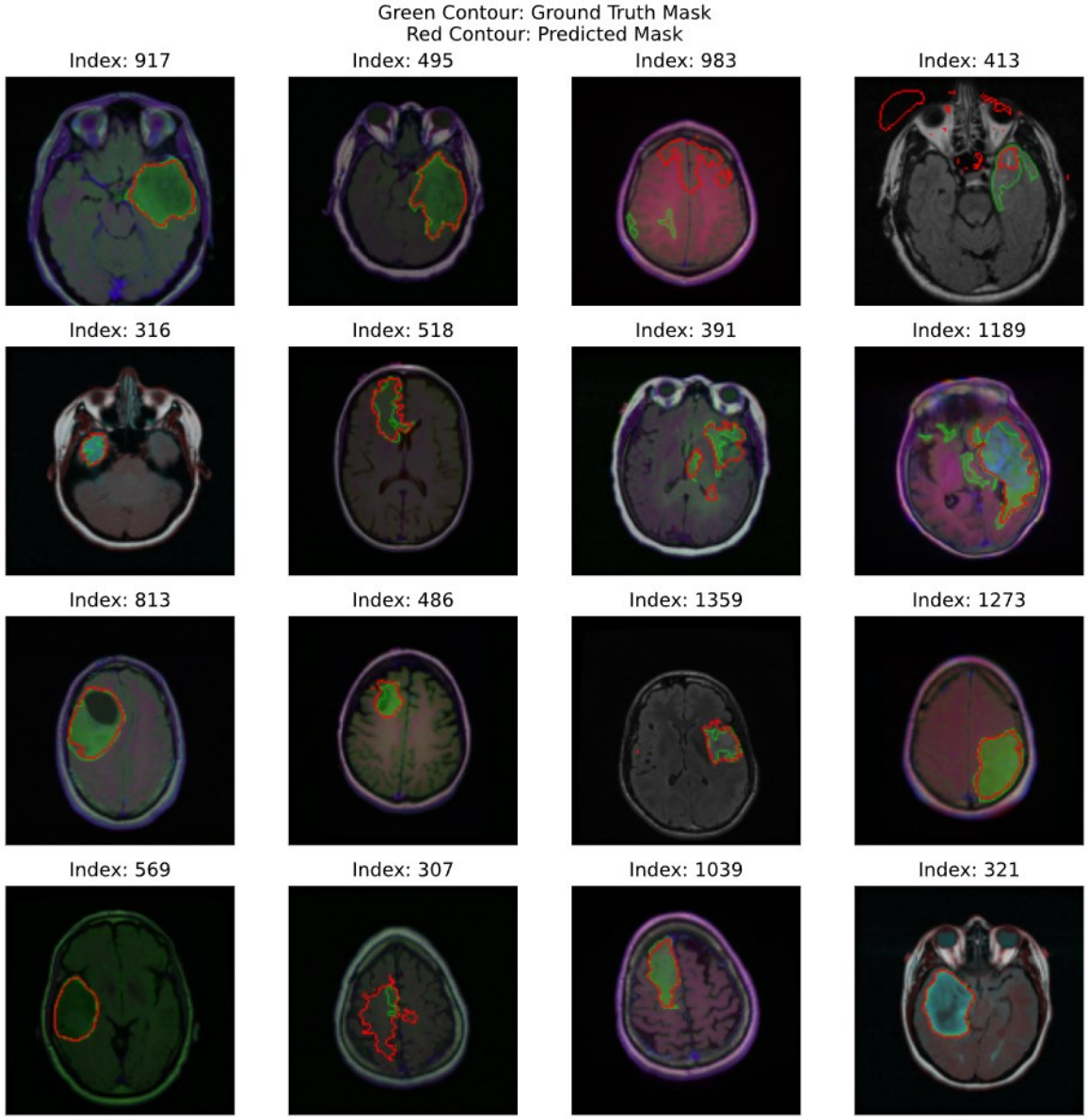


- **Model architecture:** U-Net network
- **Loss function:** Dice Loss
- **Optimizer:** Adam
- **Learning step:** 0.001
- **Training time:** approx. 60 mins on GPU

Loss History



Evaluation


Green Contour: Ground Truth Mask
Red Contour: Predicted Mask
Index: 917
Index: 495
Index: 983
Index: 413
Index: 316
Index: 518
Index: 391
Index: 1189
Index: 813
Index: 486
Index: 1359
Index: 1273
Index: 569
Index: 307
Index: 1039
Index: 321

Discussion and Next steps

- **Conclusion**
  - The U-Net model demonstrates considerable potential in segmenting gliomas from MRI images, indicating a strong foundation for further refinement and application in clinical settings.

- **Next Steps**
  - Optimize image preprocessing techniques to improve model accuracy.
  - Experiment with different loss functions to find the most effective for this specific segmentation task.
  - Expand the model's training to include images without tumors to evaluate its diagnostic accuracy comprehensively.