

Brain Segmentation Using U-Net

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Abstract

MRI can provide important information for surgeon before the surgery and provide researchers more immediate information to study the organ structure. However, manually extracting is always costly. This experiment utilized a deep learning model to segment the brain automatically and achieved a great performance.

1 Introduction

In this experiment, we replicated a deep learning model with the U-Net architecture [1] to segment the brain MRI. After simply amended the input and output, we can easily utilize this model to segment brain MRI in different size with a high accuracy.

2 Method

2.1 Preprocessing

The image data we used in this experiment is Calgary-Campinas-359 [2](CC-359) dataset, which contains the brain MRI and the corresponding brain mask of 359 patients. However, images varied significantly between patients in terms of size, for instance, the aspect ratio of some images in this dataset are about 1:2 but others are 2:1. In order to make these image data have the same size to be segmented by the fully convolutional neural network. We need to preprocess the image data by the following steps:

- Use 'load_nii' function in MATLAB to obtain slices and masks from the '.nii.gz' file.
- Pad zeros to the slices and masks at the same time according to their aspect ratio.
- Center crop the slices and masks into size of 256*256.

2.2 Segmentation

We kept the structure of the original model but used different dataset to train the neural network. After training on CC0001-CC0030 of CC-359, about 5000 slices, we got the Average Dice coefficient of 98.36% on 7 groups of slices, as shown in Figure 1. Examples of segmentations with ground truth masks presented in Figure 2.

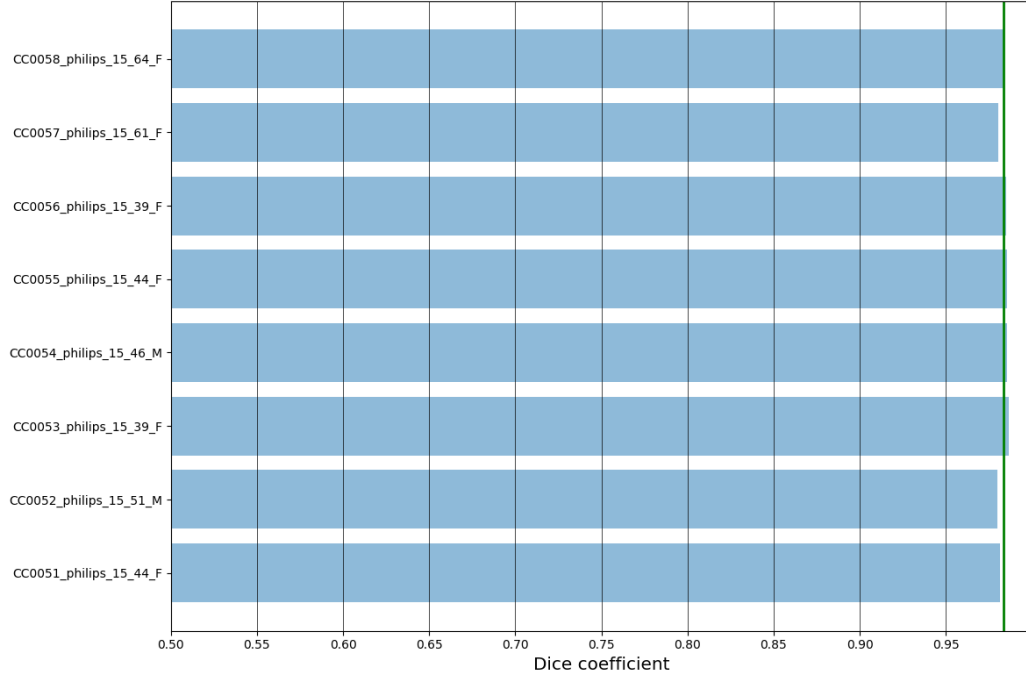


Figure 1: Dice Coefficient of Test data

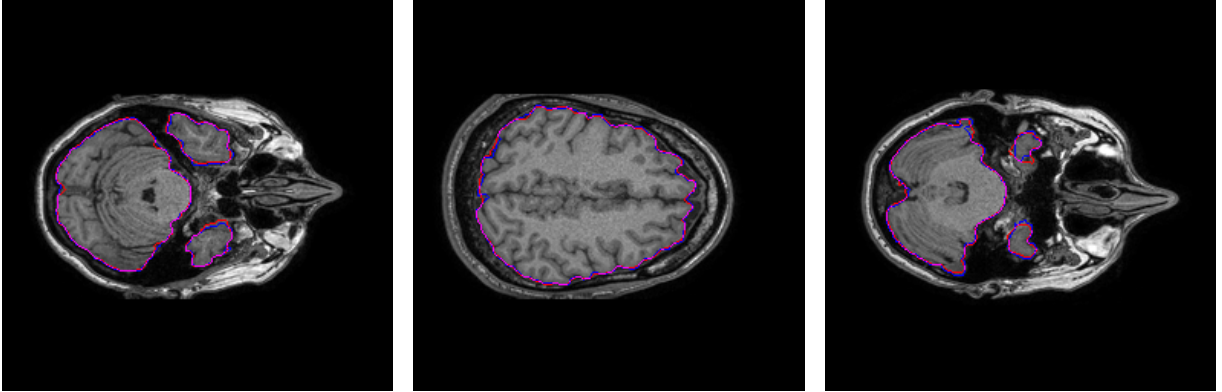


Figure 2: Examples of segmentation

2.3 Postprocessing

After predicting by the trained model, we got the prediction information in the 'mat' format. Then, we added these slices and predicted masks up respectively and convert them back to '.nii.gz' file.

3 Conclusion

In conclusion, we replicated this deep learning model and make it easier to execute even the image data are in significantly various sizes, apart from that, we also converted the prediction results into the common format, which is convenient for researchers to analyse.

References

- [1] Mateusz Buda, Ashirbani Saha, and Maciej A Mazurowski. Association of genomic subtypes of lower-grade gliomas with shape features automatically extracted by a deep learning algorithm. *Computers in Biology and Medicine*, 109, 2019.
- [2] Zou K.H. Warfield, S.K. and W.M. Wells. Simultaneous truth and performance level estimation (staple): an algorithm for the validation of image segmentation. In *IEEE transactions on medical imaging*, pages 903–921. IEEE, 2004.