Post-Stroke Lesion Segmentation Using Cascaded Convolutional Neural Networks

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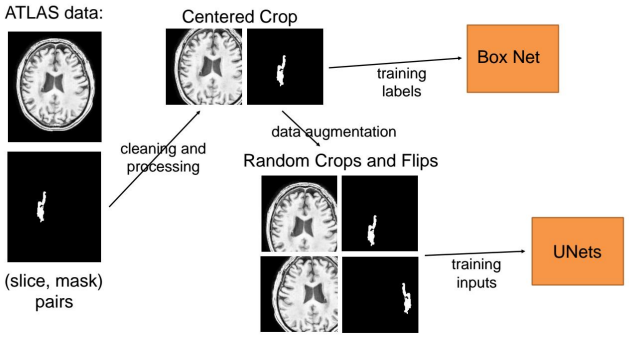
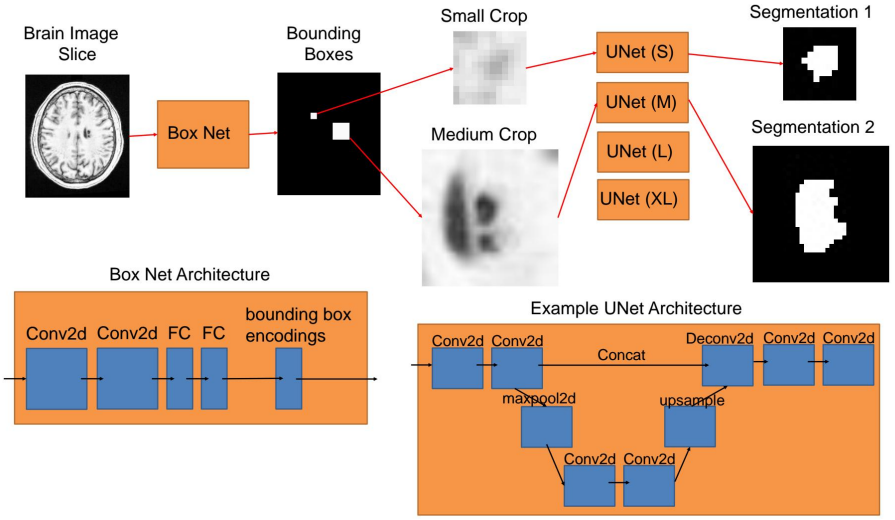
Motivation

ATLAS is a dataset released in February 2018 that contains post-stroke lesion segmentations. It would be extremely beneficial to automate the lesion segmentation process, which is manually intensive and requires extensive anatomical knowledge, because it is a barrier to large scale neuroimaging analysis. We attempt to automate the process using a cascaded convolutional neural network.

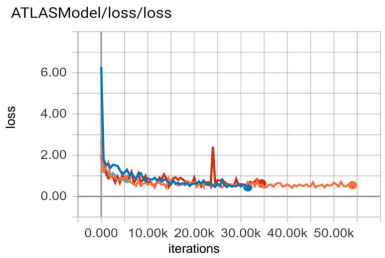
Training Set and Data Augmentation

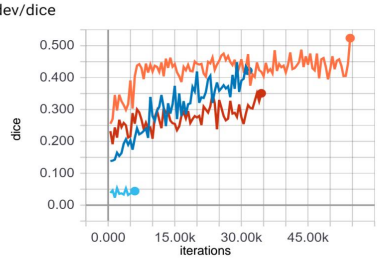


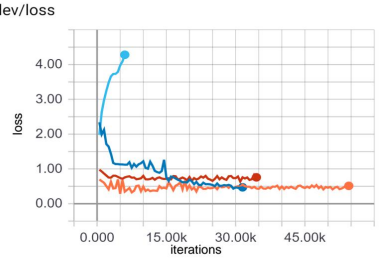
Model and Architectures



Experiment Results and Model Performance







Legend: S/. M/. L/. XL/.

Performance Metric: $\text{DICE} = \frac{2\text{TP}}{2\text{TP} + \text{FP} + \text{FN}}$ where TP, FP , and FN are the true positive, false positive, and false negative pixels in the predicted mask

Conclusions & Future Work

- The S, M, and L networks were all able to achieve more than 0.30 DICE on the dev set. The M network was able to achieve 0.50.
- The XL network took an infeasible amount of time to train, and it ultimately overfit the training set.
- Further hyperparameter tuning and architecture search can improve the XL network performance.

References

1. Sook-Lei Liew, Julia M. Anglin, Nick W. Banks, Matt Sondag, Kaori L. Ito, Hosung Kim, Jennifer Chan, Joyce Ito, Connie Jung, Stephanie Lefebvre, William Nakamoto, David Sultzer, Allie Schweinsburg, Cathy Tran, Danny Vu, Tyler Ard, Panthea Heydari, Bokkyu Kim, Lisa Aziz-Zadeh, Steven C. Cramer, Jingchun Liu, Sonja Soekadar, Jun-Egil Nordvik, Lars T. Westlye, Jianping Wang, Carolee Winstein, Chunshui Yu, Lei Ai, Bonhwang Koo, R. Cameron Craddock, Michael Milham, Matthew Lakich, Amy Pienta, and Allison Stroud, *The anatomical tracings of lesions after stroke (atlas) dataset - release 1.1*, bioRxiv (2017).
2. Olaf Ronneberger, Philipp Fischer, and Thomas Brox, *U-net: Convolutional networks for biomedical image segmentation*, CoRR **abs/1505.04597** (2015).
3. Guotai Wang, Wenqi Li, Sébastien Ourselin, and Tom Vercauteren, *Automatic brain tumor segmentation using cascaded anisotropic convolutional neural networks*, CoRR **abs/1709.00382** (2017).

VIDEO LINK

- https://drive.google.com/open?id=1DOopFbvdiiJTwjMWR3KX6pTUATQIySLS