PYTORCH CONFERENCE

“Brainchop” In browser MRI volumetric segmentation and rendering

PyTorch tool

Mohamed Masoud
Farfalla Hu
Sergey Plis

Georgia State University
Neuroneural
Trends

F2

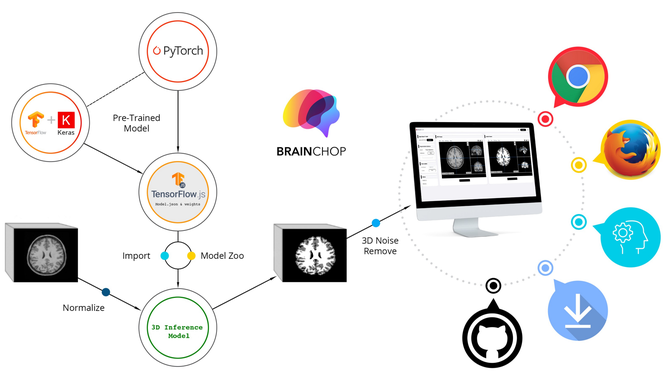
Abstract

Brainchop brings high-fidelity pre-trained deep learning models for volumetric analysis of structural magnetic resonance imaging (MRI) right to the browsers of scientists and clinicians with no requirement on their technical skills in setting up AI solutions. All of this is in an extensible open-source framework.

Our tool is the first front-end MRI segmentation tool on the web that supports full brain volumetric processing in a single pass inside a browser. This property is powered by our lightweight and reliable deep learning model Meshnet which enables volumetric processing of the entire brain at once, which leads to increased accuracy with modest computational requirements. High-quality client-side processing solves the privacy problem, as the data does not need to leave the client. Moreover, browser-based implementation can take advantage of available hardware acceleration regardless of the brand or architecture.

Pipeline

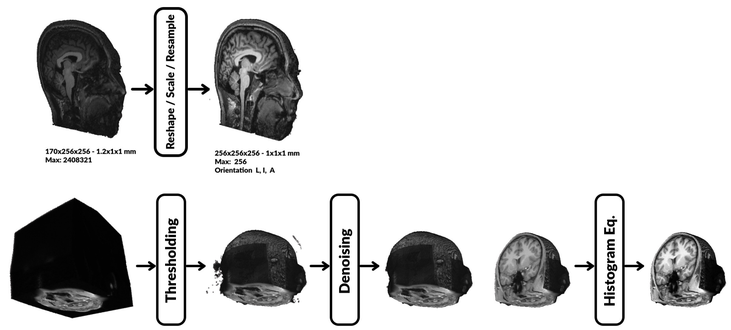
In order to deploy the PyTorch MeshNet model in the browser, there is a need to convert it first to a workable TensorFlow.js (tfjs). The tool has a preprocessing pipeline, full-volume and sub-volume inference options, 3D input/output rendering, and post-processing capability.



Data privacy, low latency, high accessibility, and zero-install are among brainchop main features.

Preprocessing

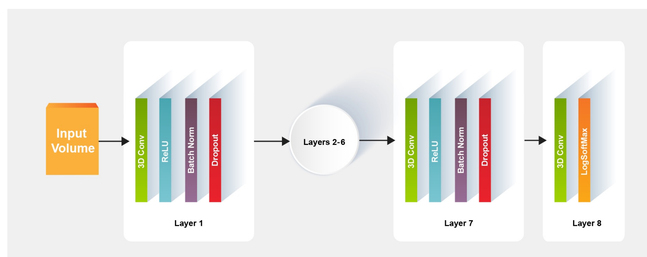
MRI preprocessing converter for reshaping/ scaling / re-sampling MRI raw input data.



The preprocessing pipeline is to remove noisy pixels and enhance input volume. Also, brainchop supports MRI tissue cropping option to speedup the inference and lower the memory use

Inference Model

The advantage of MeshNet small size is due to its simple architecture in which a typical model for the segmentation task can be constructed with eight layers as shown.

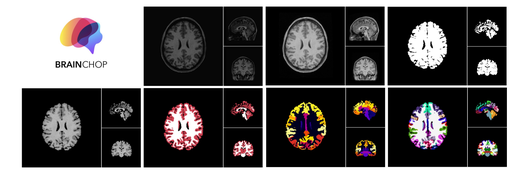


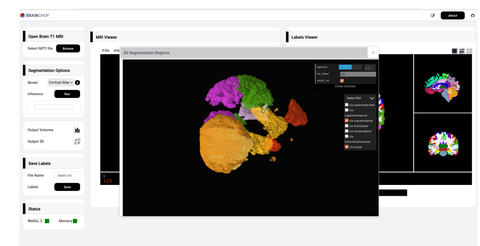
Overall Performance

Model		Inference Speed	Model Size	Macro DICE
MeshNet GMWM		116 subvolumes/sec	.89 mb	0.96
U-Net GMWM		13 subvolumes/sec	288 mb	0.96
MeshNet GMWM (full brain model)		0.001 sec/volume	0.022 mb	0.96

Results

Multiple pre-trained models are available with brainchop for full-volume and sub-volume inference including masking, GMWM segmentation, and segmentation models for 50 cortical regions and 104 cortical and sub-cortical structures.





Brainchop supports 3D real-time rendering of the output volume with ROI selection capability.

Conclusion

We show in this poster a strong proof-of-concept of the browser’s capability to quickly run volumetric brain segmentation. With an appropriate inductive bias, a model that is powerful and simultaneously economical in size and computation can find a great use for in-browser client-side applications. Our MeshNet implementation is solid evidence of this. The accessibility, scalability, ease of use, lack of installation requirements, and cross-platform operation are just a few of the other features that in-browser applications can provide while preserving end-user data privacy.

Acknowledgments

Funded by NIH RF1MH121885 “Nobrainer” project.

References

1- GitHub: https://github.com/neuroneural/brainchop
2- Web: www.brainchop.rog
3- Blog: https://trendscenter.org/in-browser-3d-mri-segmentation-brainchop-org/

BRAINCHOP

Take a photo to learn more: