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CREATE CHANGE

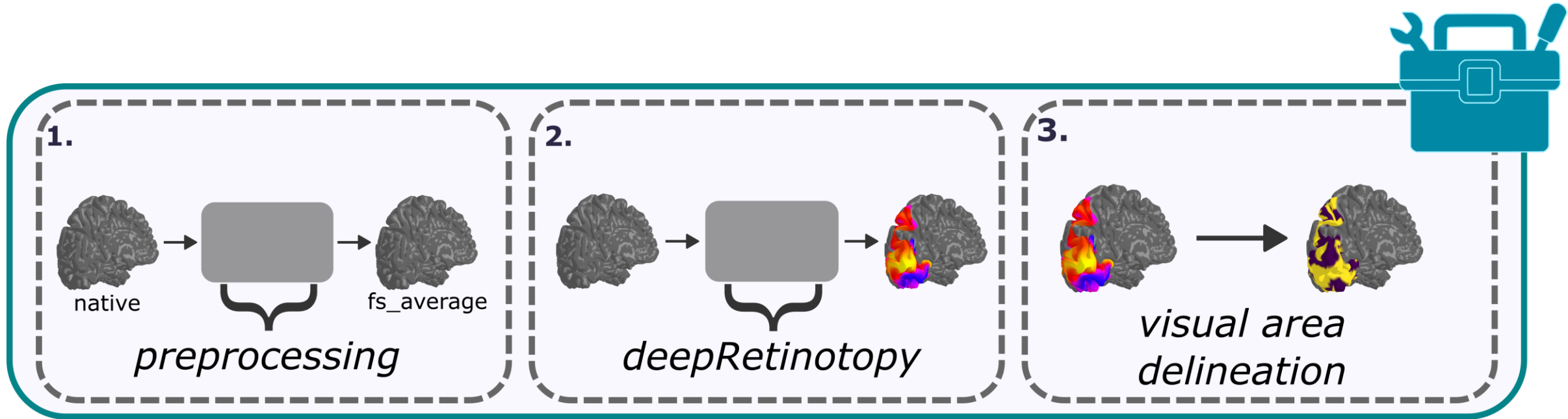
Deep learning and automation in the visual cortex

Fernanda L. Ribeiro, PhD

School of Electrical Engineering and Computer Science, The University of Queensland

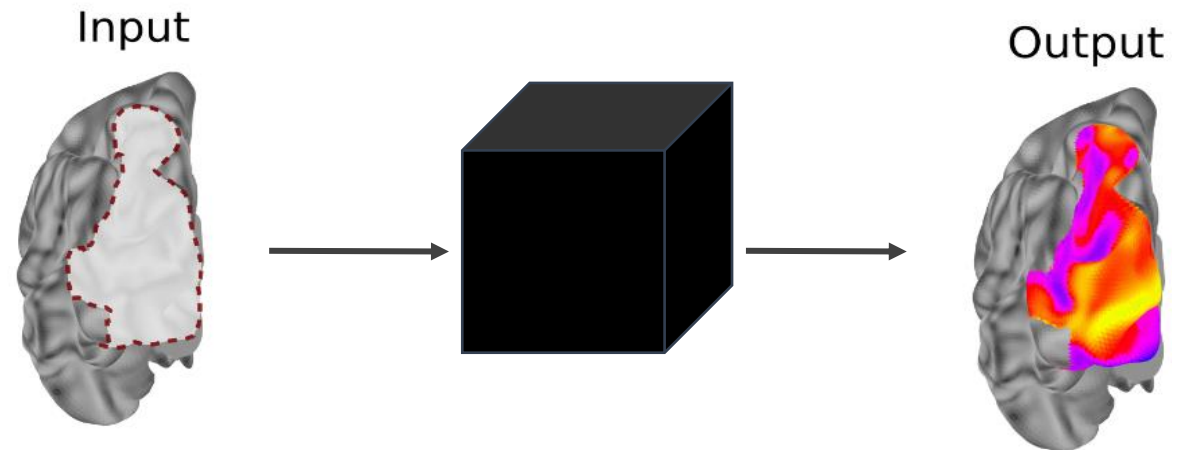


DeepRetinotopy – The Toolbox

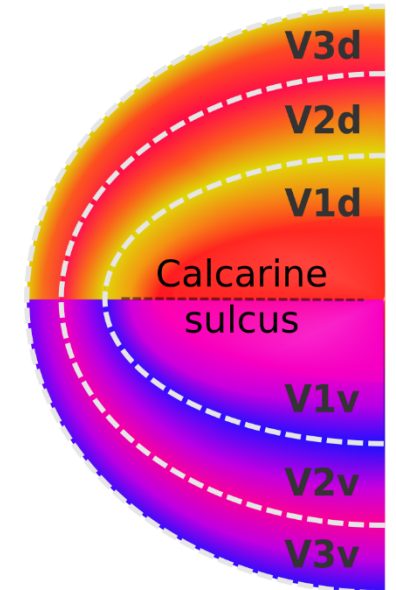
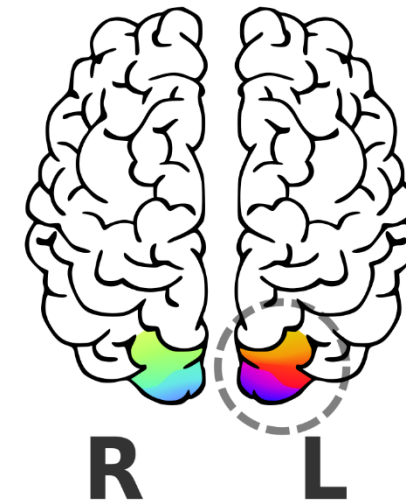
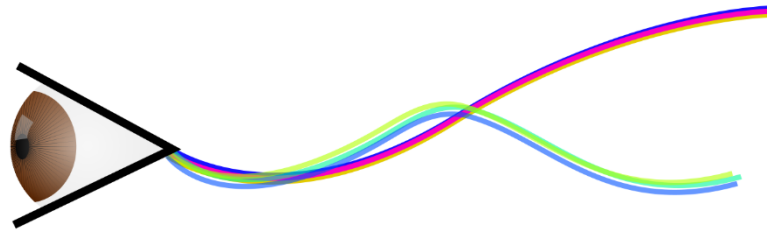
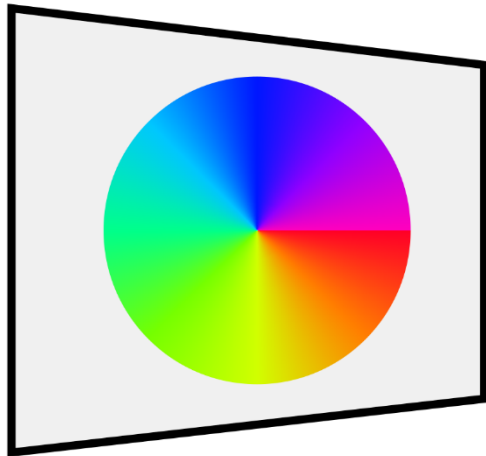


Renton, Dao et al.,
Nature Methods (2024)

Part 1 – Predicting retinotopic maps with deepRetinotopy



Fine scale



Acquisition of experimental data



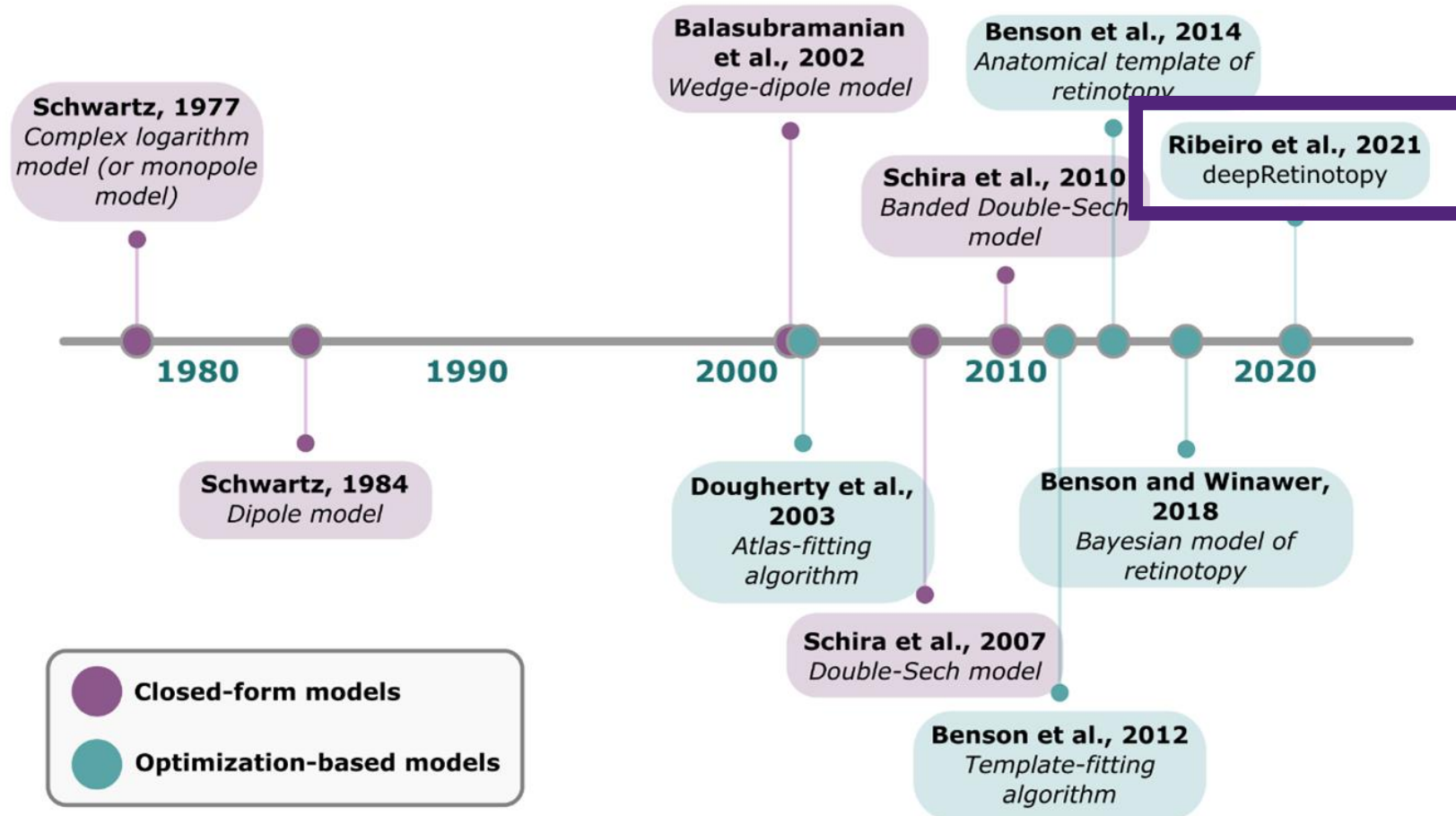
- Time consuming
- Expensive
- Clinical population

<https://cai.centre.uq.edu.au/facilities/human-imaging/7t-magnetom>

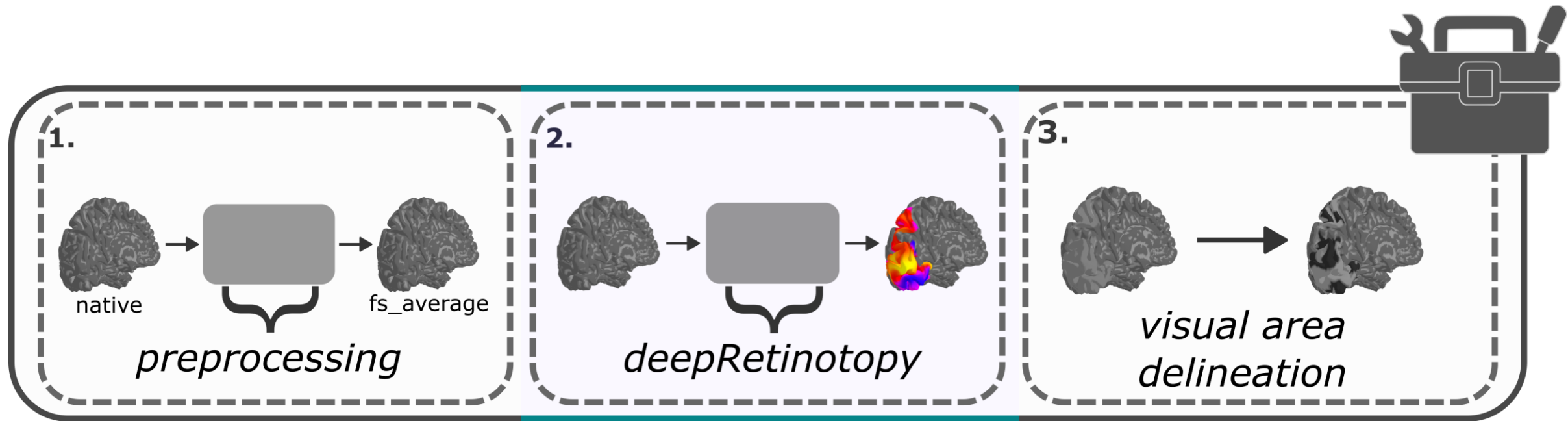
Models of Retinotopy

Ribeiro, Benson, and Puckett, *under review*

Models of retinotopic organization in human visual cortex



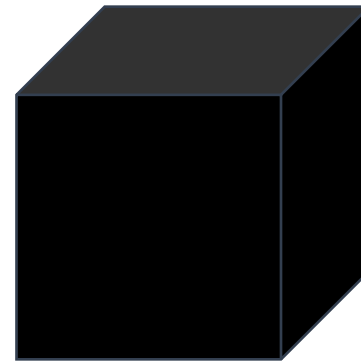
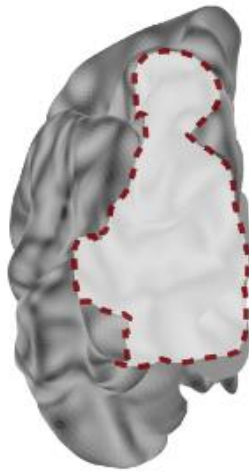
DeepRetinotopy – The Toolbox



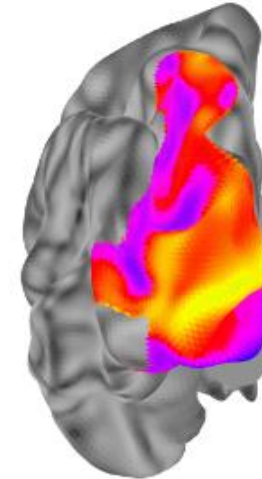
DeepRetinotopy



Input



Output



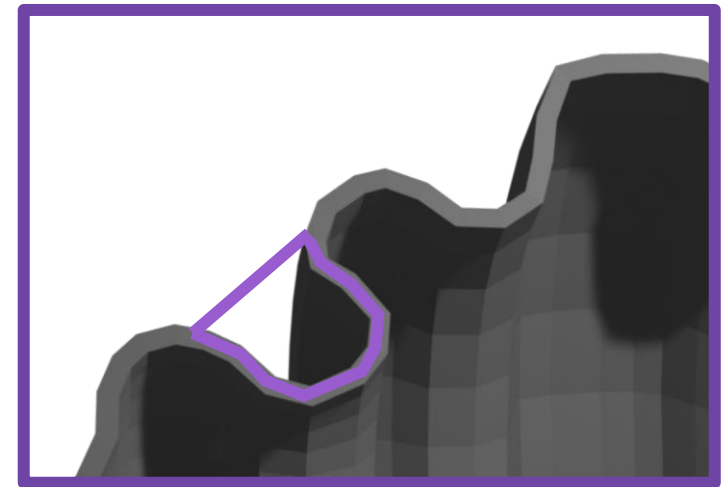
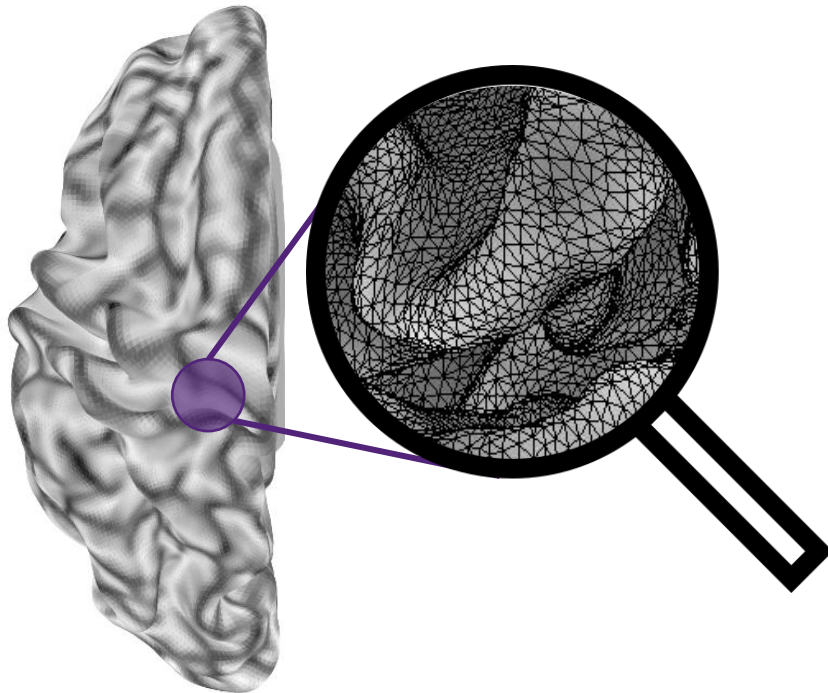
Ribeiro, Bollmann, and Puckett,
NeuroImage (2021)

- Surface topology;
- Vertices' coordinates;
- Feature vectors;

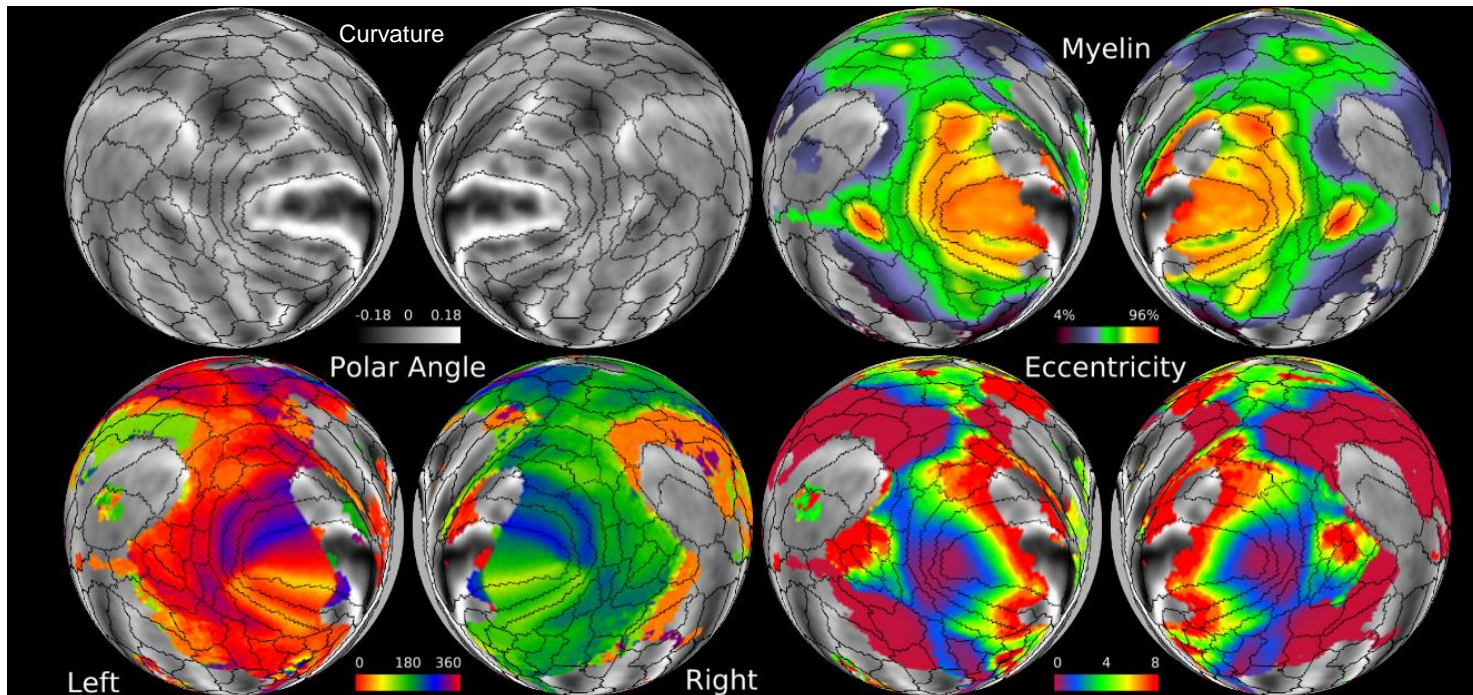
- Polar angle / eccentricity;

Non-Euclidean data in Neuroscience

Cortical surface



Human Connectome Project



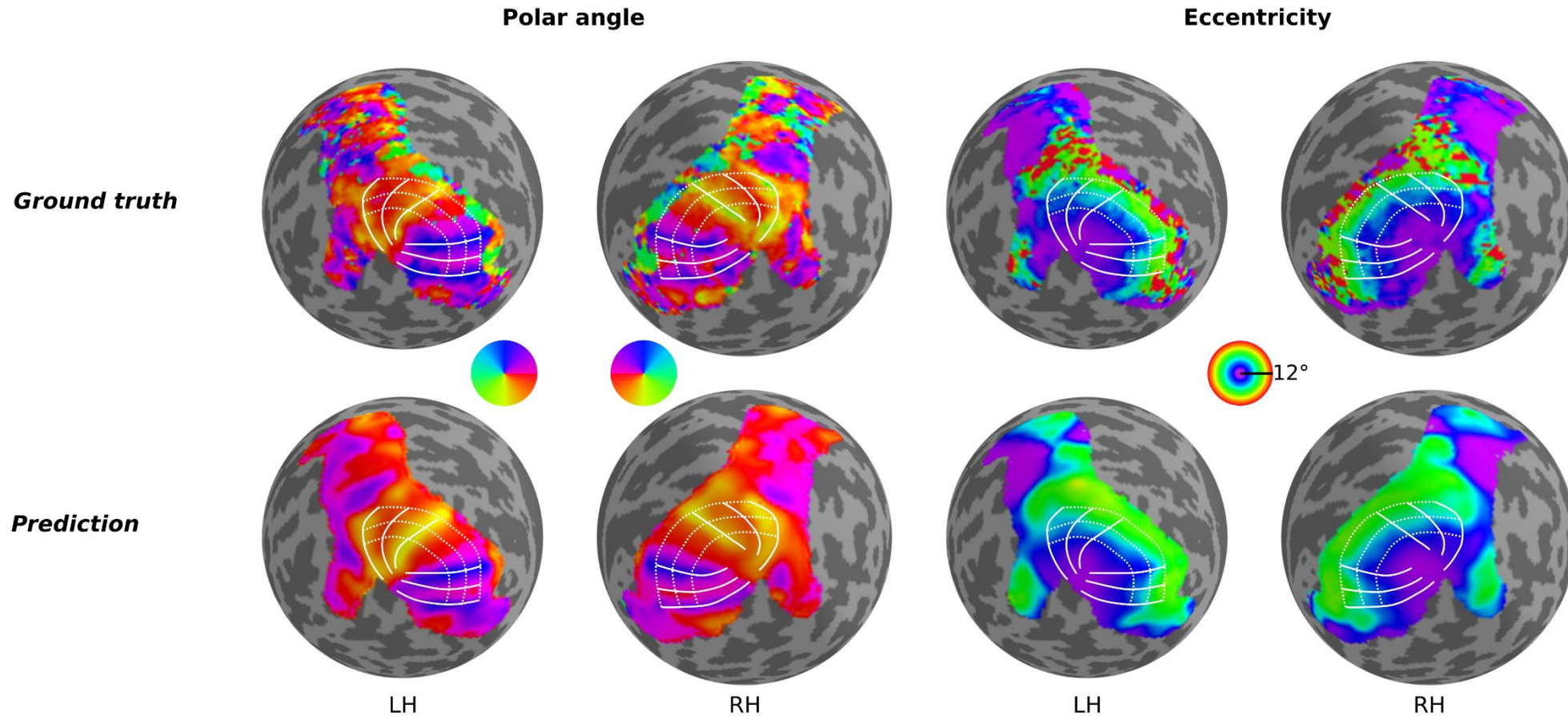
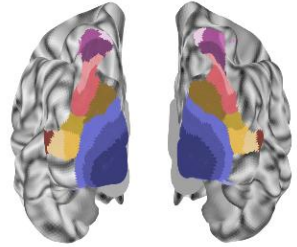
High-resolution data from 181 participants:

- Anatomical data
 - Curvature
 - Myelin
- Functional data
 - Polar angle
 - Eccentricity

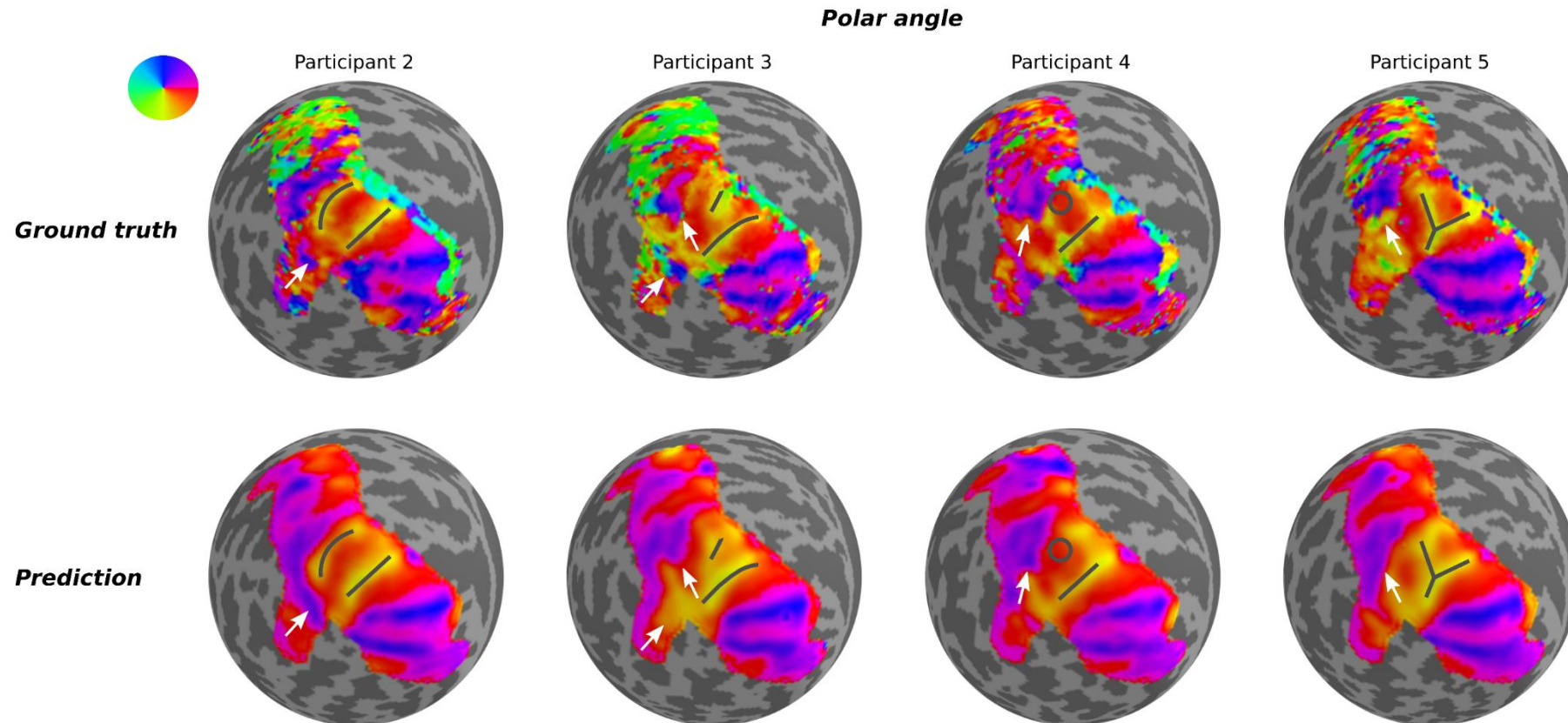
<https://balsa.wustl.edu/study/show/9Zkk>

Benson et al., Journal of Vision (2018)

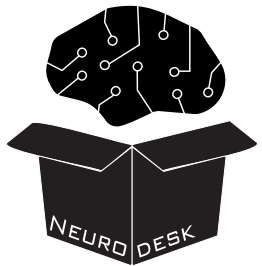
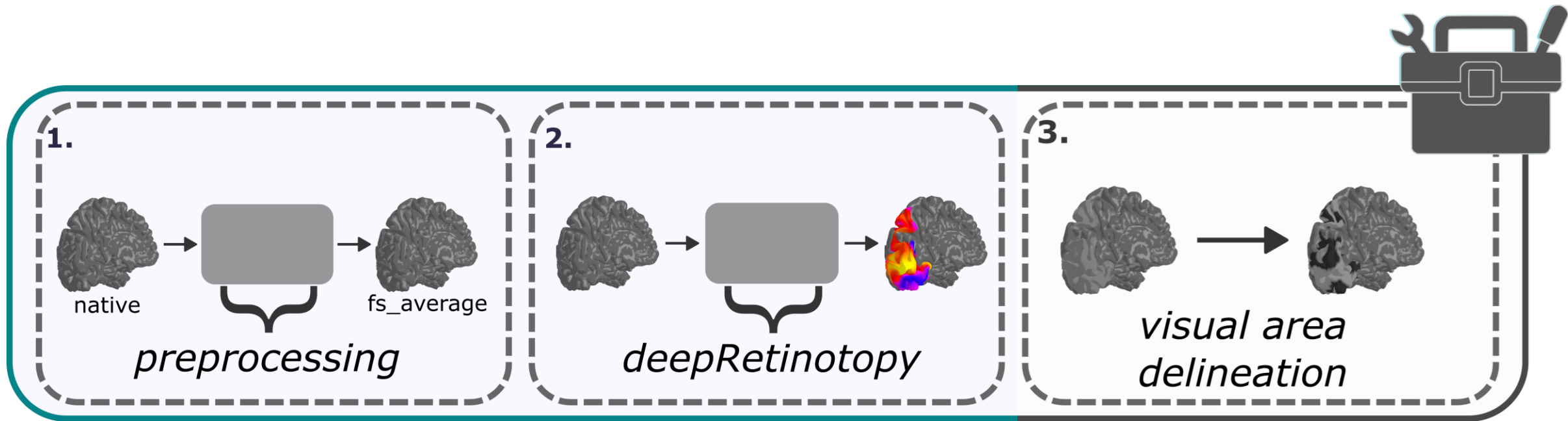
Retinotopic mapping with geometric deep learning



DeepRetinotopy – Individual variability

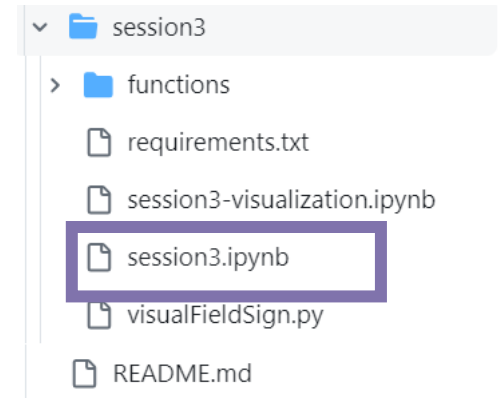


DeepRetinotopy – The Toolbox

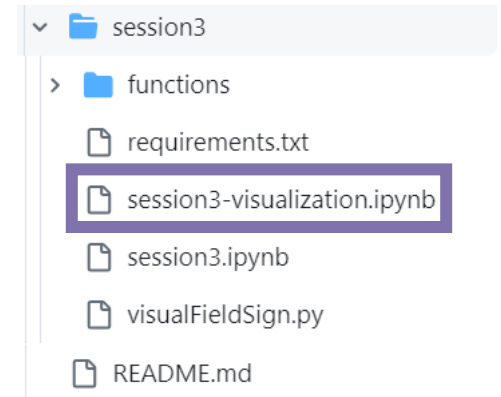


Renton, Dao et al.,
Nature Methods (2024)


Let's generate (or almost) some
retinotopic maps for a participant in
the NYU dataset!



When you are done, then it is visualization time!



Do you want to contribute?

 **deepRetinotopy_TheToolbox** Public Unpin Unwatch 1 Fork 0 Star 1

main 2 Branches 0 Tags Add file <> Code

felenitaribeiro path to log file (#25) 78964eb · 3 weeks ago 180 Commits	
.github/workflows	Update test_module1.yml (#15) 5 months ago
labels	major reorganization 7 months ago
main	checks for potential error (#21) 4 months ago
tests	updating the tests (#24) last month
tmp	major reorganization 7 months ago
utils	Sign analysis (#19) 4 months ago
.cirun.yml	check runners 7 months ago
LICENSE	Create LICENSE 2 years ago
README.md	update container version (#22) 3 months ago
deepRetinotopy	path to log file (#25) 3 weeks ago
environment.yml	steps all together 7 months ago

About

General toolbox for predicting human retinotopic maps using deepRetinotopy.

- Readme
- GPL-3.0 license
- Activity
- 1 star
- 1 watching
- 0 forks

Releases

No releases published
[Create a new release](#)

Packages

No packages published
[Publish your first package](#)

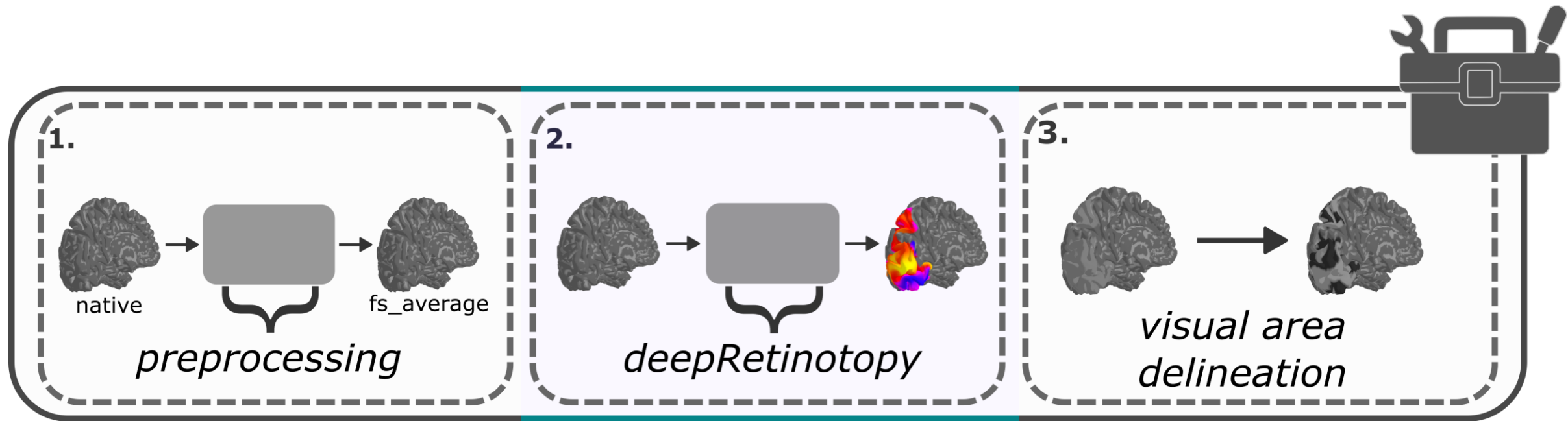
Languages



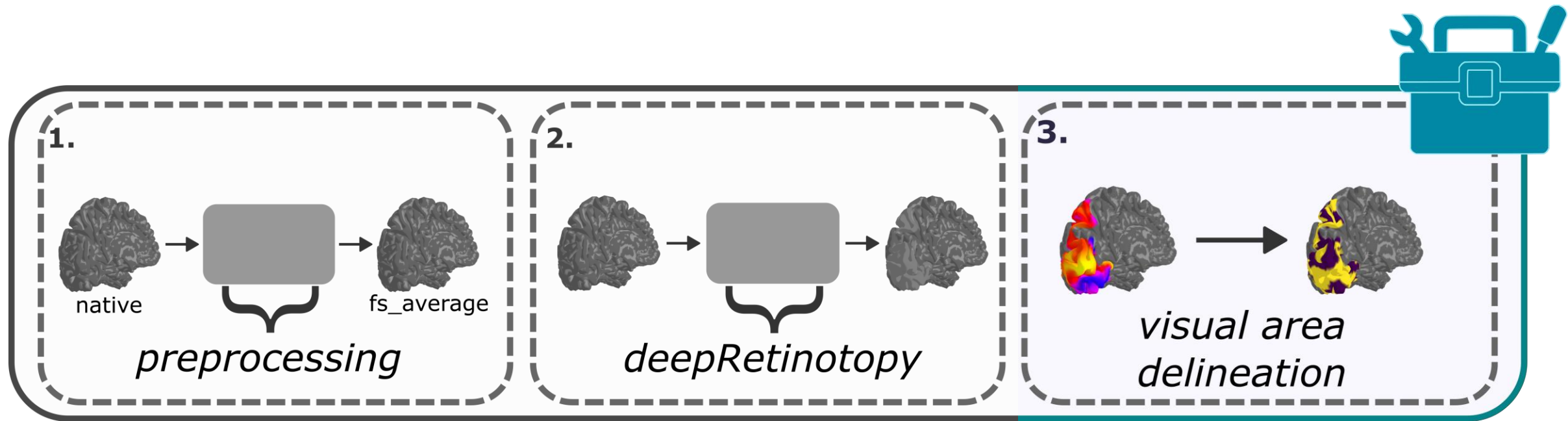
https://github.com/felenitaribeiro/deepRetinotopy_TheToolbox

Part 2 – Could we automate visual area boundary delineation? Maybe...

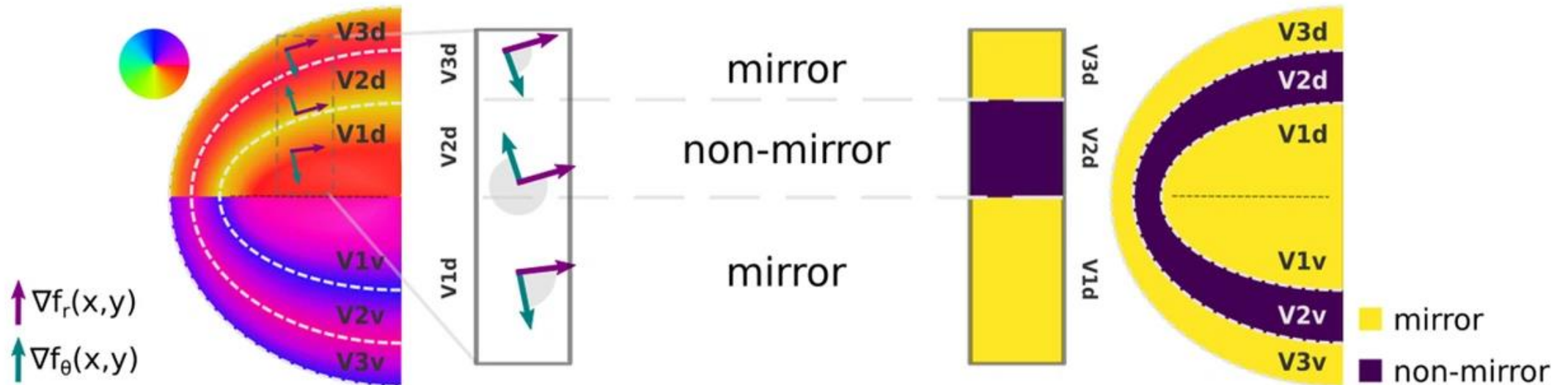
DeepRetinotopy – The Toolbox



DeepRetinotopy – The Toolbox



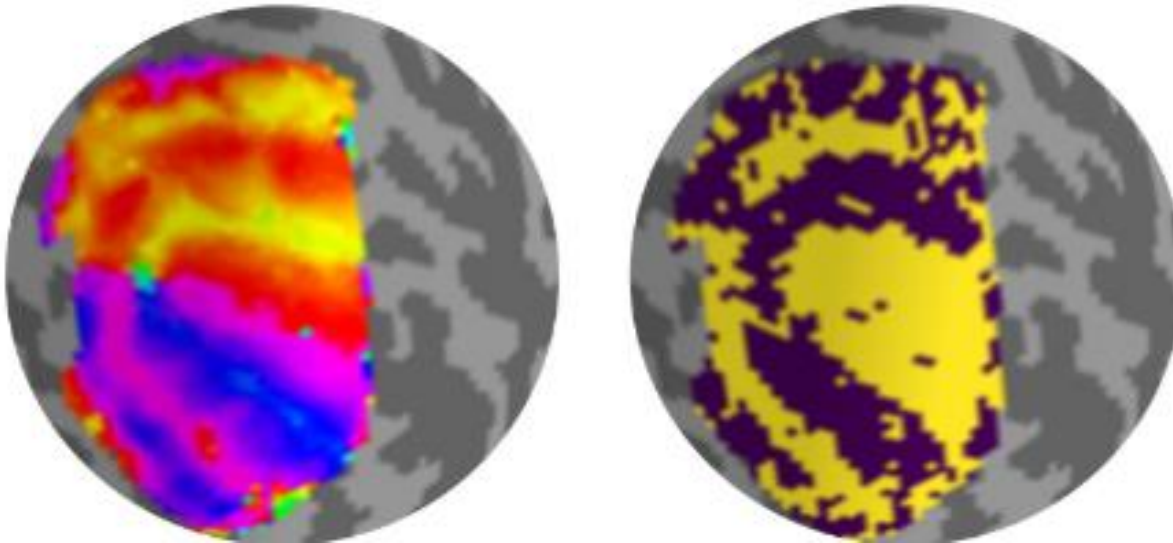
Visual field sign analysis



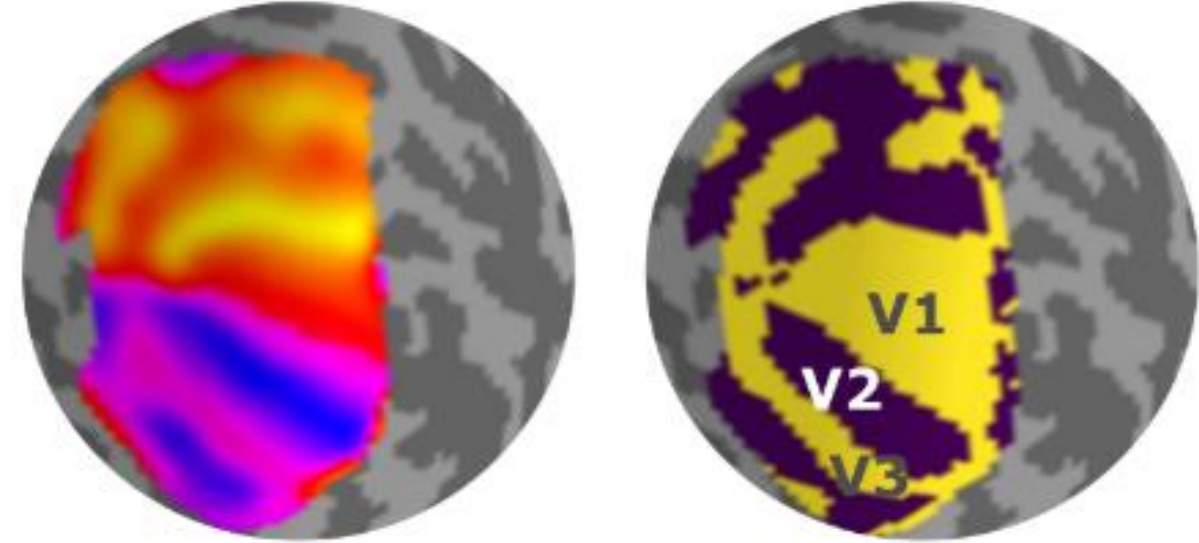
Sereno et al., Science (1995);
Sereno et al., Cerebral Cortex (1994);
Ribeiro et al., eLife (2023)

Visual field sign analysis

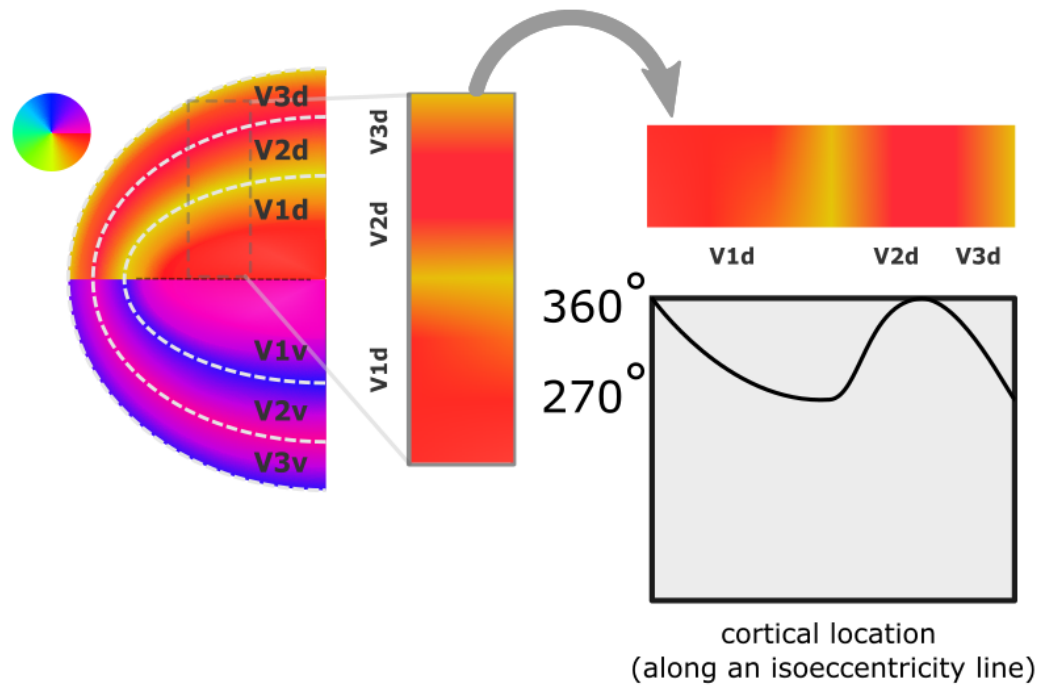
Noisy empirical data =
noisy sign maps



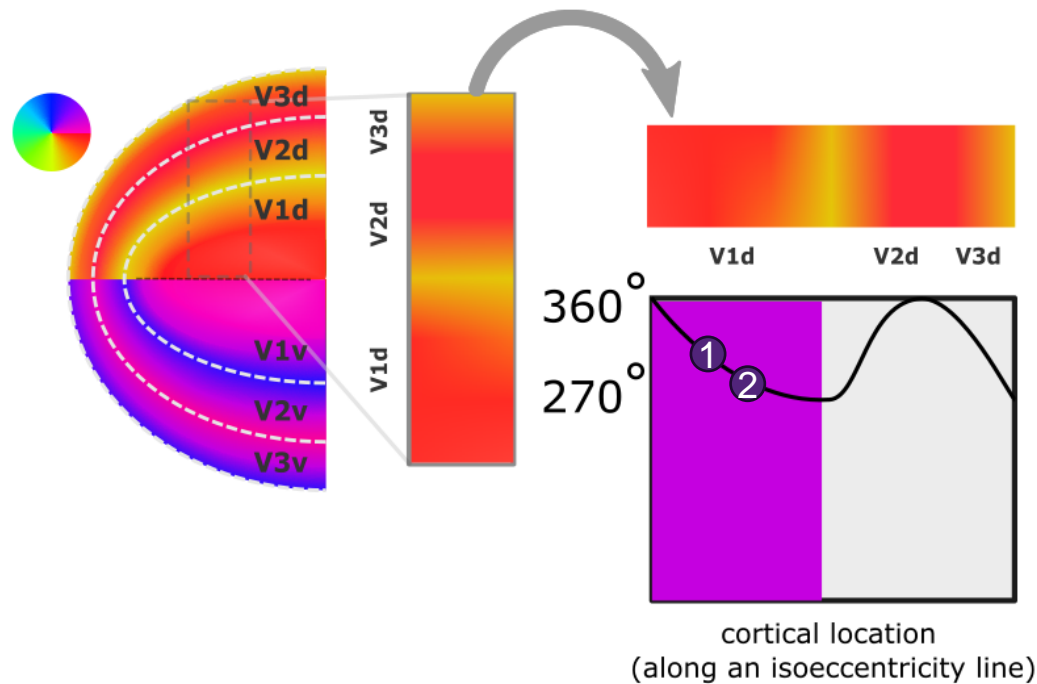
Smooth predicted data =
good-looking sign maps!



Sign map or rate of change or derivatives



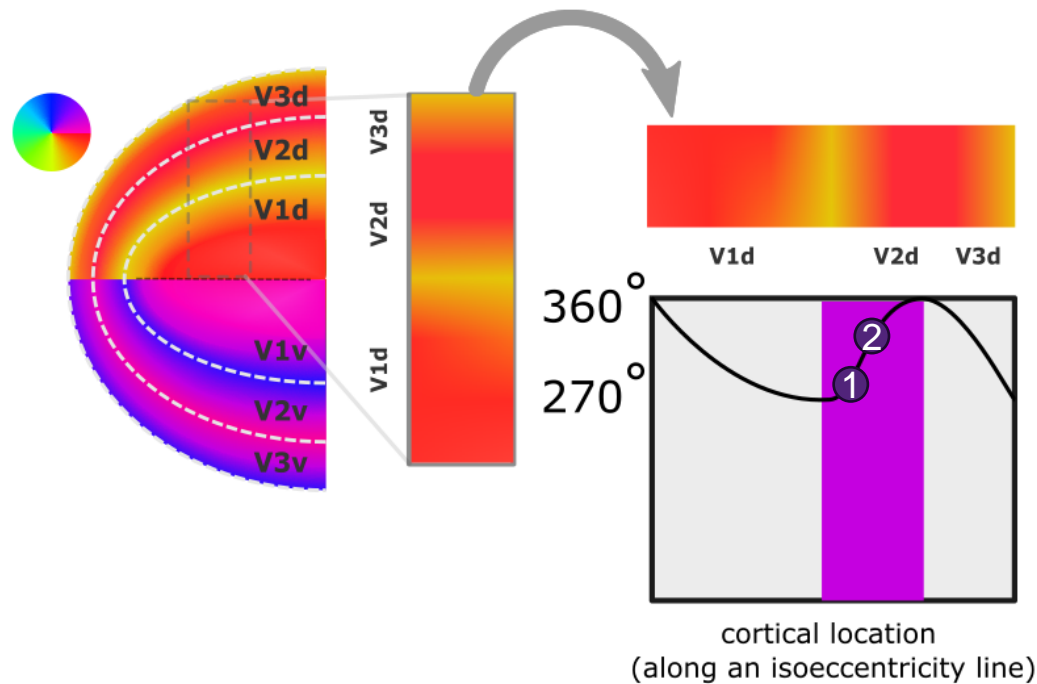
Sign map or rate of change or derivatives



$$\text{rate of change} = \frac{(\text{angle2} - \text{angle1})}{(\text{location2} - \text{location1})}$$

Negative!

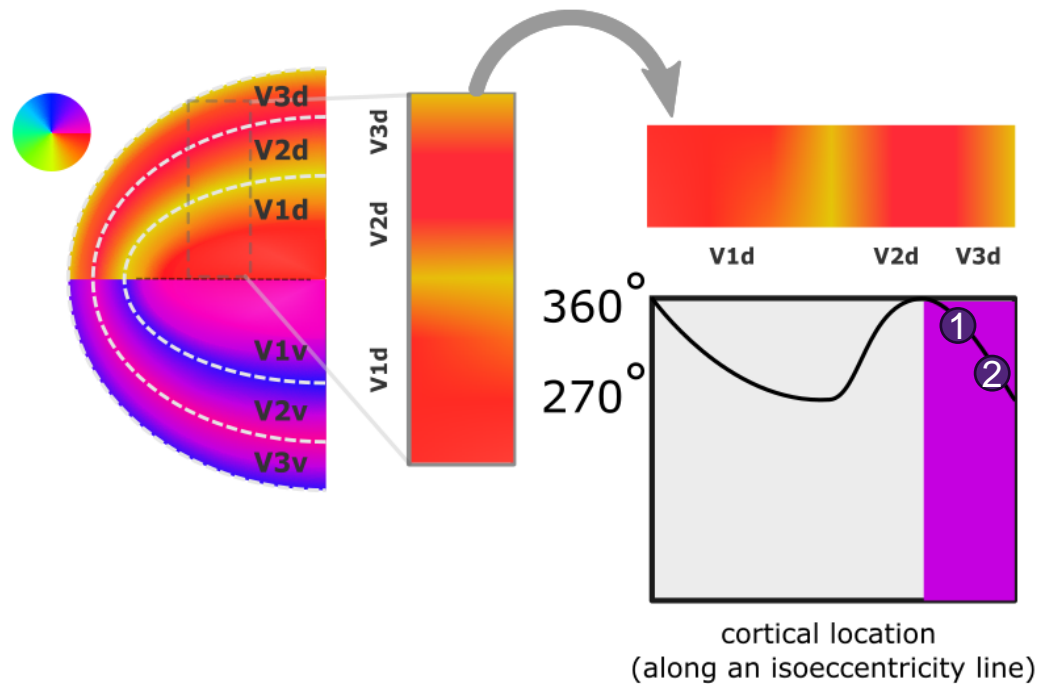
Sign map or rate of change or derivatives



$$\text{rate of change} = \frac{(\text{angle2} - \text{angle1})}{(\text{location2} - \text{location1})}$$

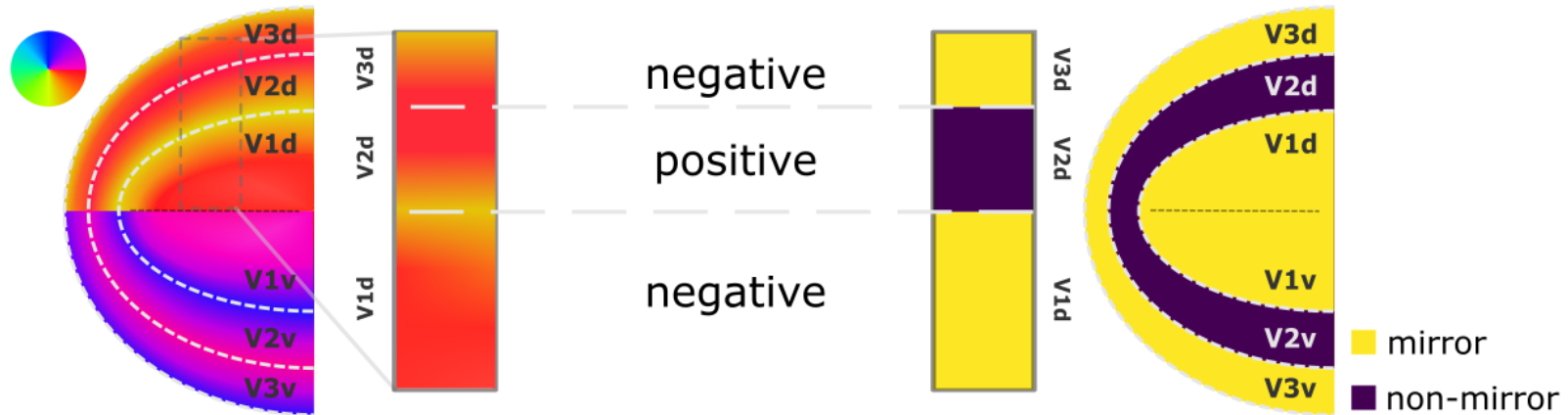
Positive!

Sign map or rate of change or derivatives

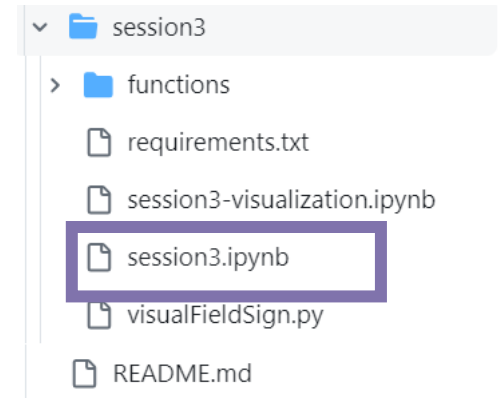


$$\text{rate of change} = \frac{(\text{angle2} - \text{angle1})}{(\text{location2} - \text{location1})}$$

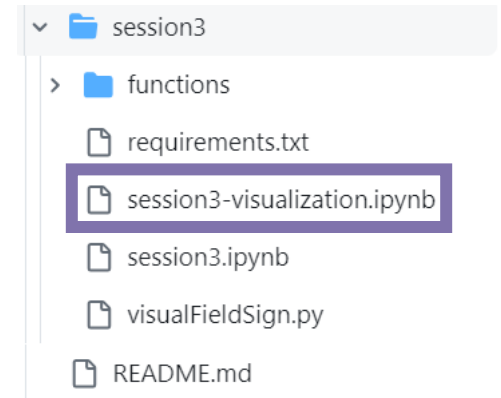
Negative!



Let's generate sign maps from the predicted retinotopic maps we got in part 1!



When you are done, then it is visualization time!





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Thank you!

