



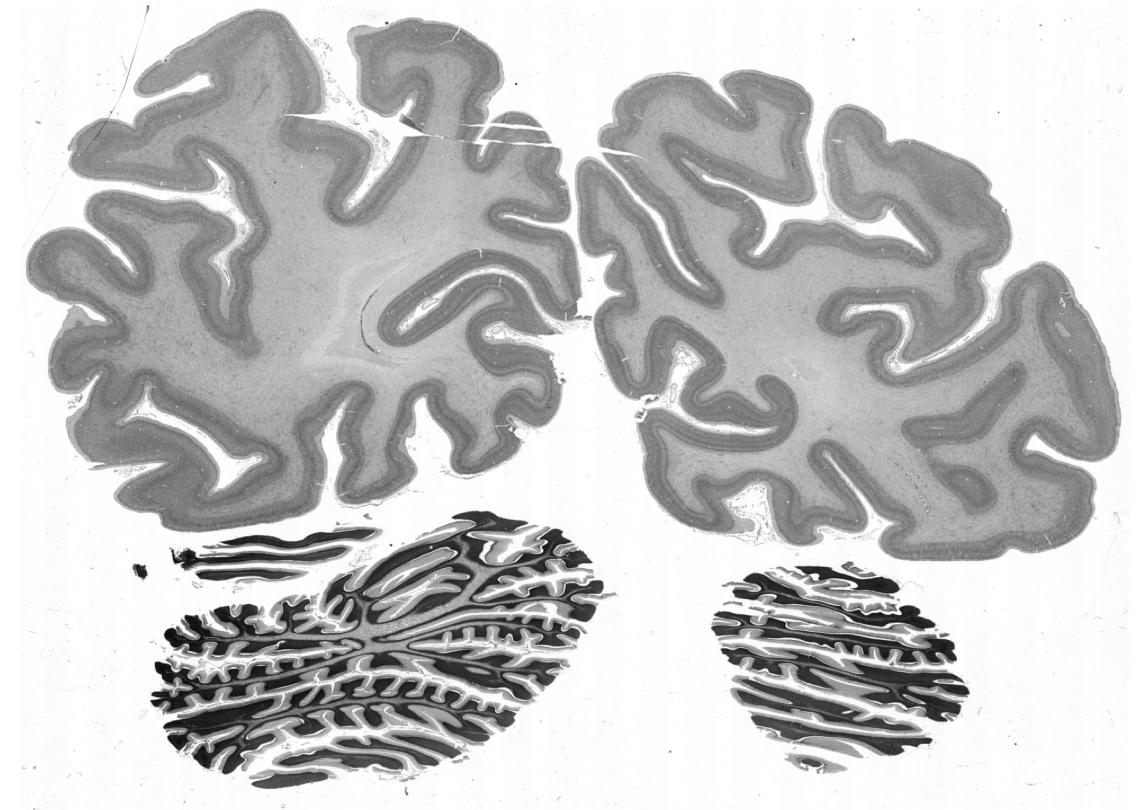
SEGMENTATION OF HISTOLOGICAL SECTIONS IN THE BIGBRAIN

OHBM EDUCATIONAL COURSE DEEP LEARNING FOR HUMAN BRAIN MAPPING

09.06.2019 | HANNAH SPITZER

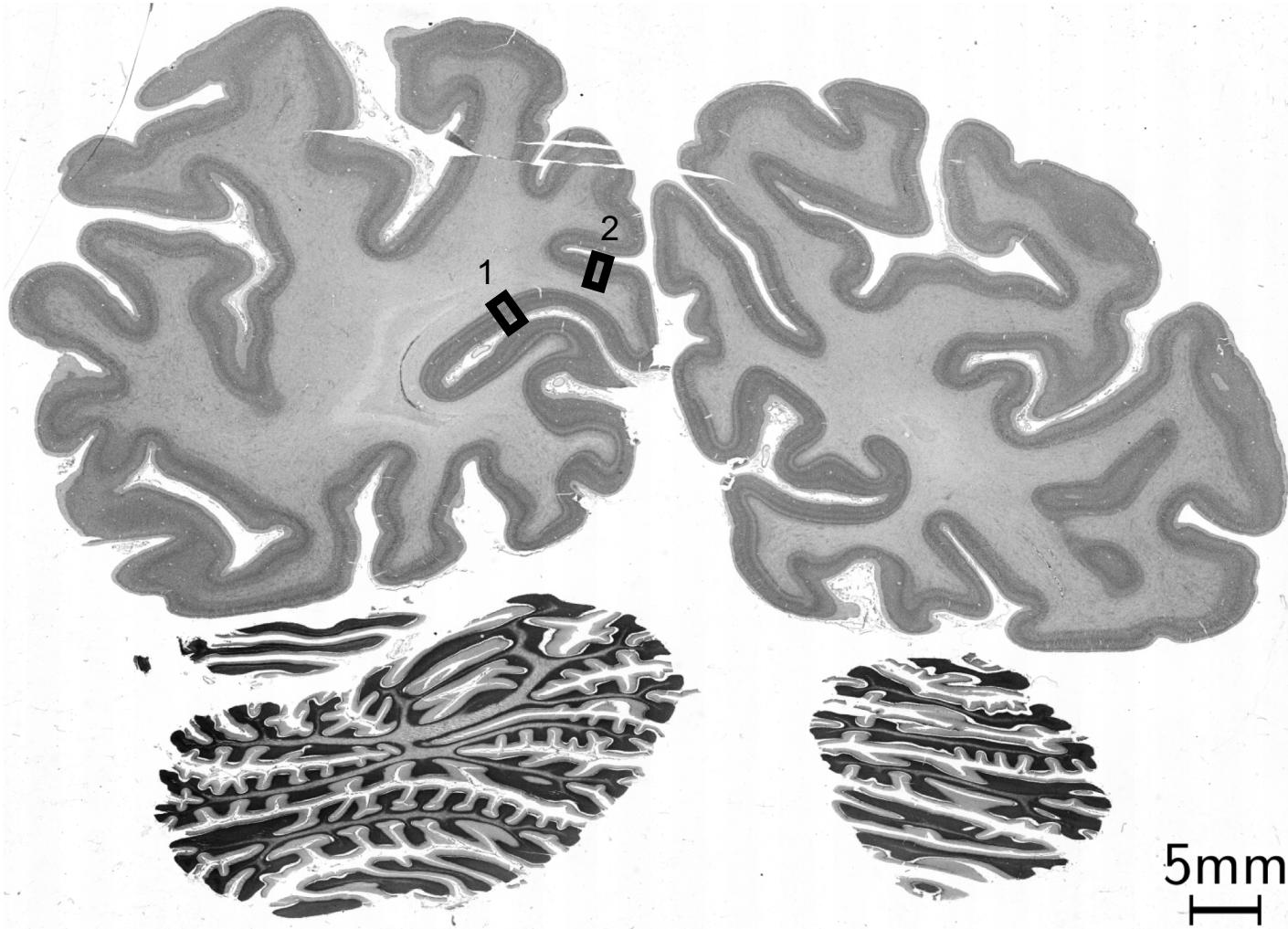
HISTOLOGICAL SECTIONS

20um thick tissue sections, cell-body stained, imaged at 20um-1um per pixel resolution



CYTOARCHITECTONIC BRAIN AREAS

Cytoarchitecture: Distribution, size, and type of neurons

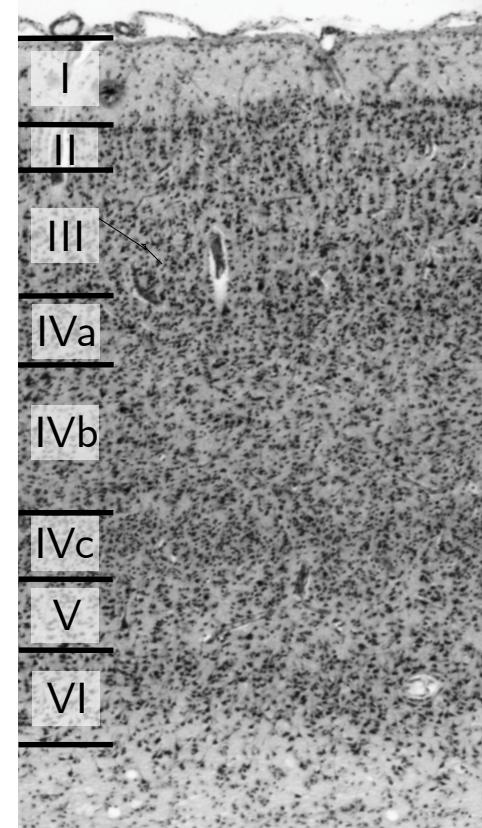


5mm

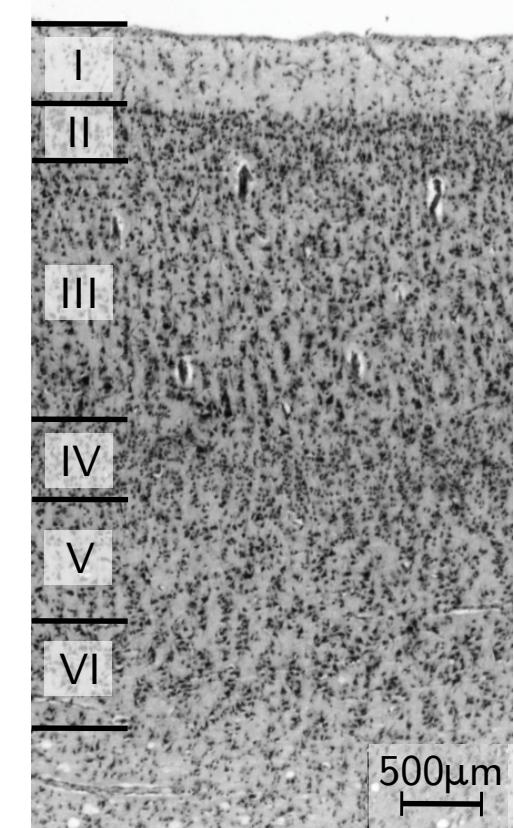
Mitglied der Helmholtz-Gemeinschaft

Hannah Spitzer | DL4HBM

Primary visual cortex
(V1/hOc1)



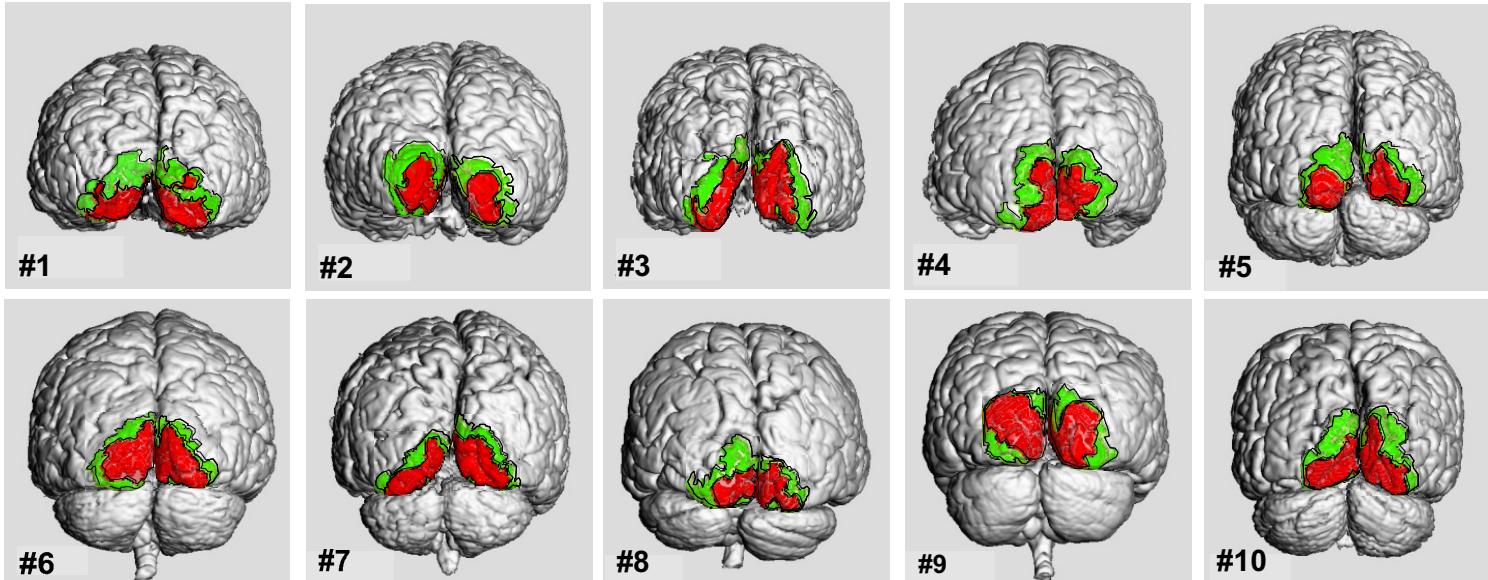
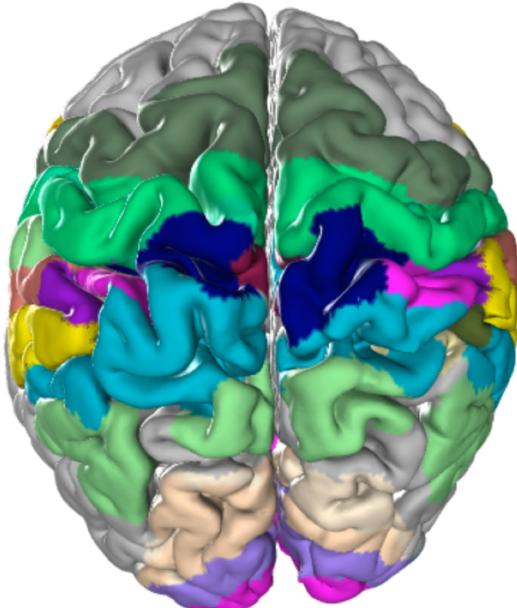
Secondary visual cortex
(V2/hOc2)



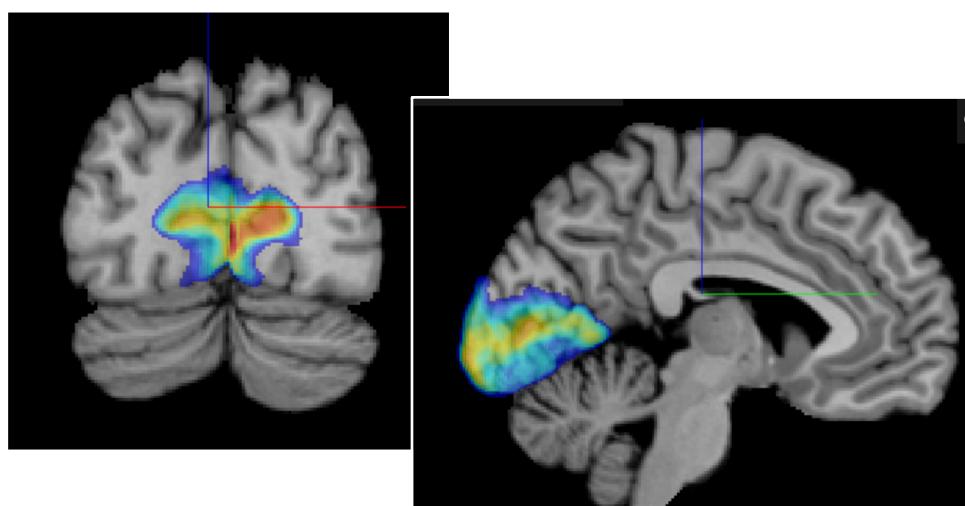
500µm

WHY STUDY CORTICAL AREAS?

- Analysis of structural areas in multiple subjects shows inter-individual variability
- JuBrain probabilistic atlas of brain areas allow allocation of functional, connectivity, genetic, etc. data to structurally well-defined entities

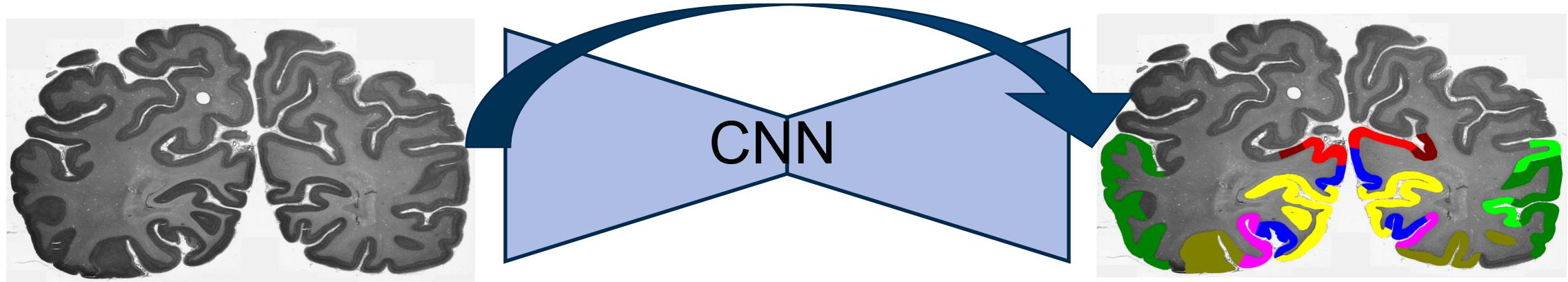


Amunts, Zilles et al.: Brodmann's Areas 17 and 18 Brought into Stereotaxic Space—Where and How Variable?, *NeuroImage*, 2000



AUTOMATIC ANALYSIS OF HISTOLOGICAL SECTIONS

Convolutional Neural Networks (CNN) segment high-resolution histological sections in brain areas



Spitzer / Amunts / Harmeling / Dickscheid (2017):
Parcellation of visual cortex on high-resolution
histological brain sections using convolutional neural
networks, ISBI 2017

Spitzer / Dickscheid et al. (2018):
Improving Cytoarchitectonic Segmentation of Human
Brain Areas with Self-supervised Siamese Networks,
MICCAI 2018

This tutorial gets you started on your own CNN
for segmentation of histological sections

SCOPE OF THE TUTORIAL

Data: 20um sections of the BigBrain

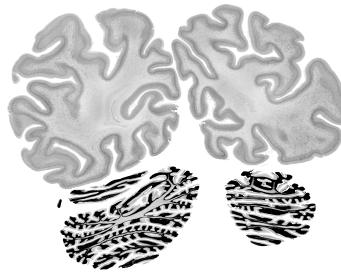
- 1um sections are too large to process in an interactive setting, need GPU cluster

Task (1): Gray/white matter segmentation

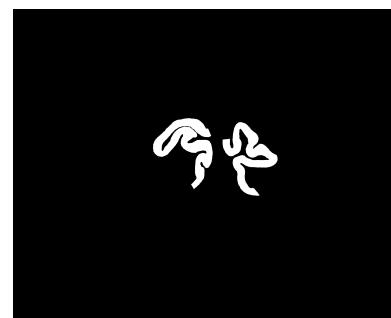
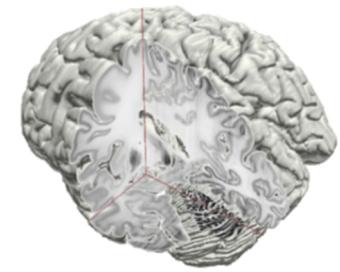
- Easier than area segmentation, good use-case for testing architectures and parameters
- Needs less training data and shorter training times
- Important task for preprocessing and pre-training of more complex models

Task (2): V1 (primary visual cortex) segmentation

- Distinctive structure of V1 visible on 20um sections
- „Easy“ area but still harder task than gm/wm segmentation



Amunts / Evans et al (2013):
BigBrain: An Ultrahigh-
Resolution 3D Human Brain
Model, Science 2013



Kiwitz / Amunts et al (2019).
Reference delineations of Area hOc1 (V1, 17, Calcs) in individual sections of the BigBrain [Data set]. Human Brain Project Neuroinformatics Platform. DOI: [10.25493/3GSV-T4A](https://doi.org/10.25493/3GSV-T4A)