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3DBrainMiner, A TOOL TO GENERATE BRAIN GRAPHS FROM MR-IMAGES

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Context :

- The rise of brain imaging methods results in a substantial amount of morphological and functional data.
- We are using nonconventional animal models (quail, sheep, wild animals etc.) => less tools and databases
- Objectif 1 : transform anatomic and functional MRI of brains into graphs for better exploration
- Objectif 2 : Use graph matching or machine learning algorithms to analyze graphs

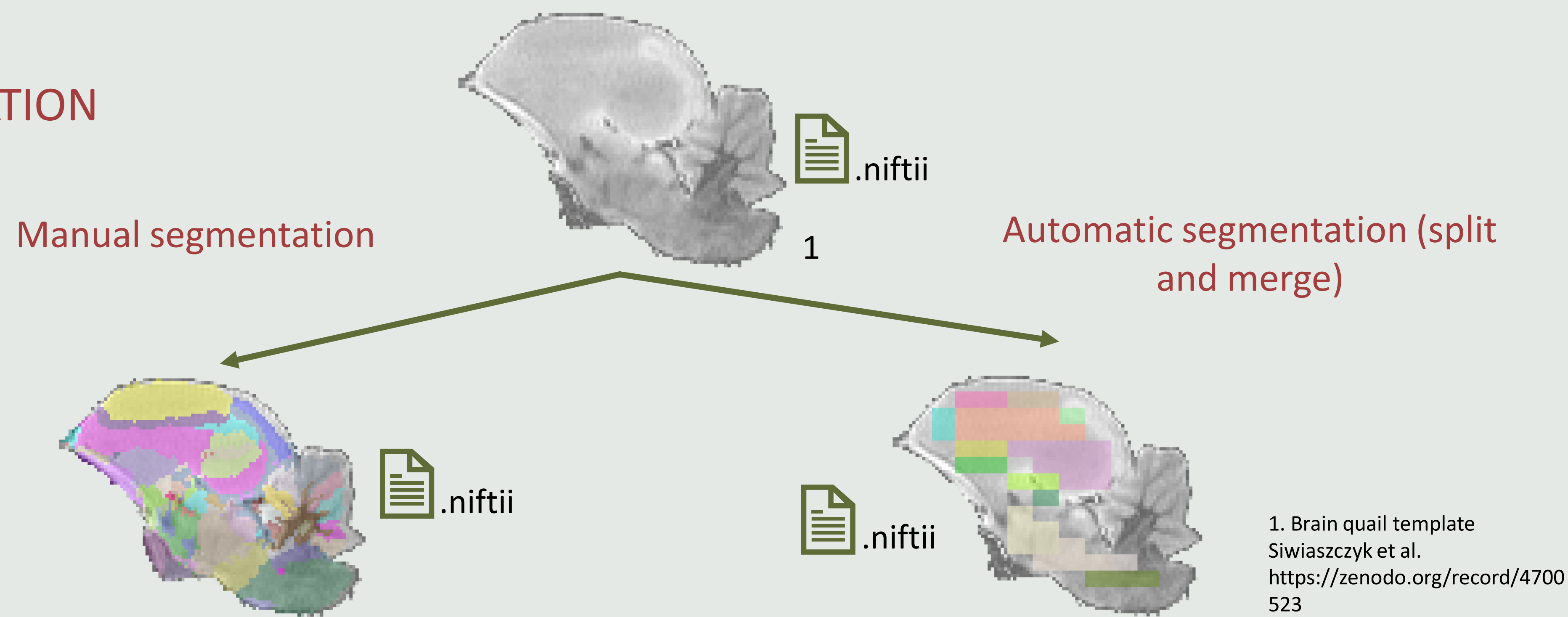
Representation of brains in the form of graphs in the literature :

NODES = structures, cells, neurons, voxels, recording electrodes, etc.
 EDGES = structural, functional, effective connections, etc.

Quail brains are used to illustrate how 3dBrainMiner works.

3dBrainMiner

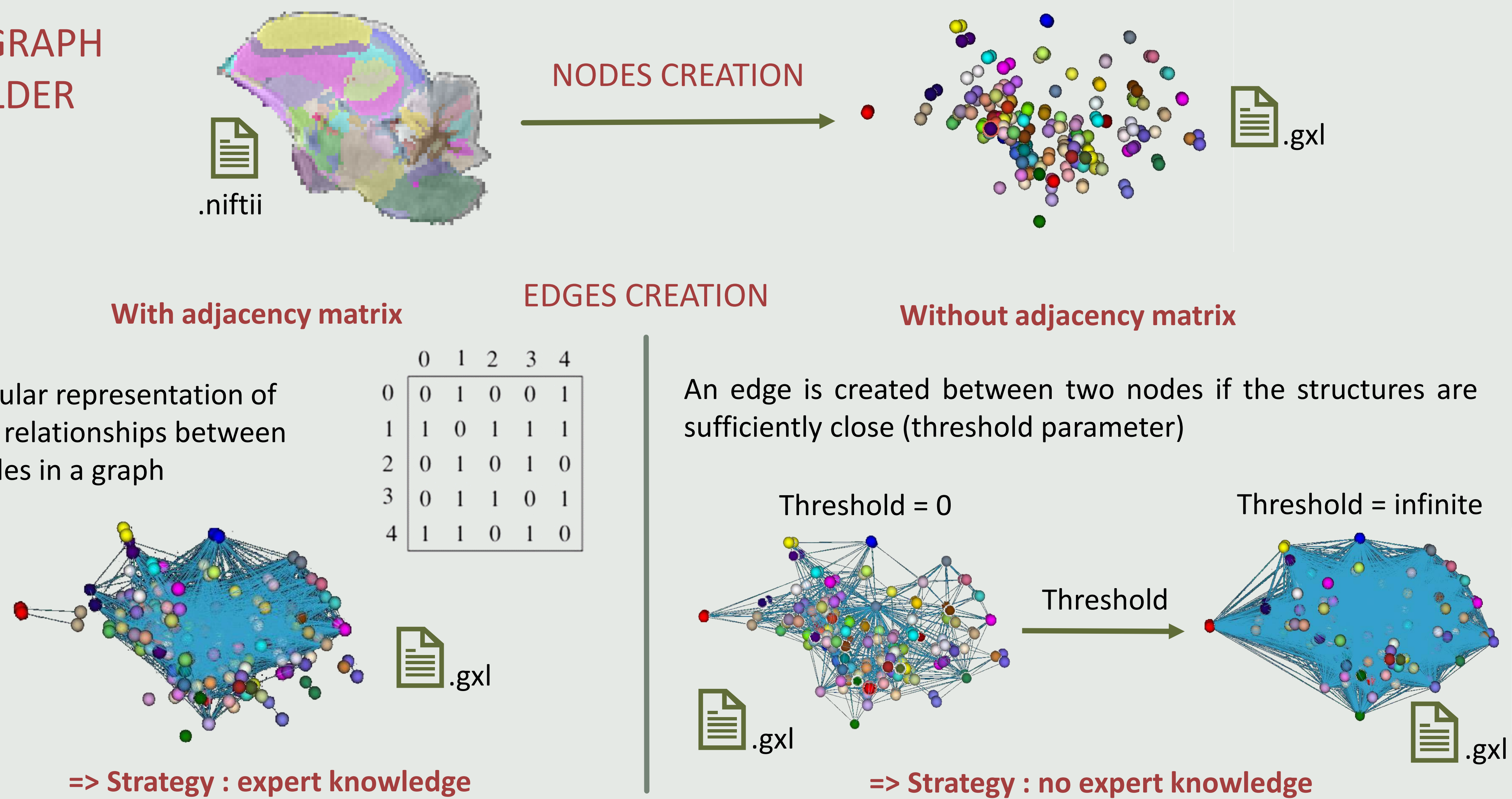
1 – BRAIN SEGMENTATION



2 - FEATURES EXTRACTOR

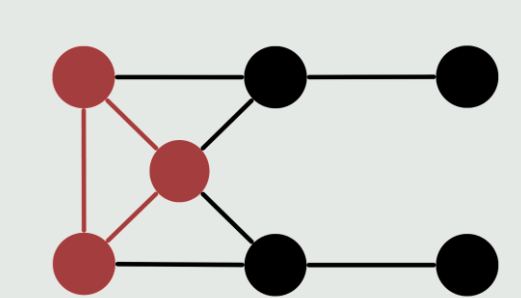
Node features		Edge features
• Mean Intensity	• Volume	• Mean distance
• Intensity variance	• Sphericity	• Min / max distances
	• Surface	• Contact surface
	• Radial profile	
	• Center of gravity	

3 - GRAPH BUILDER

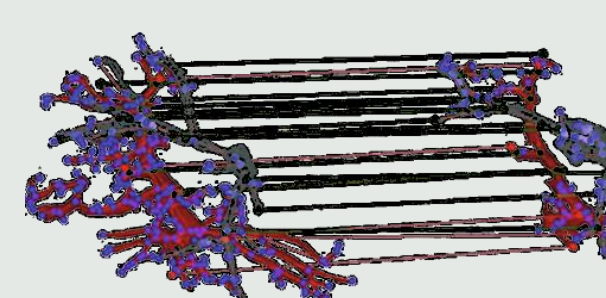


4 - GRAPH MINER

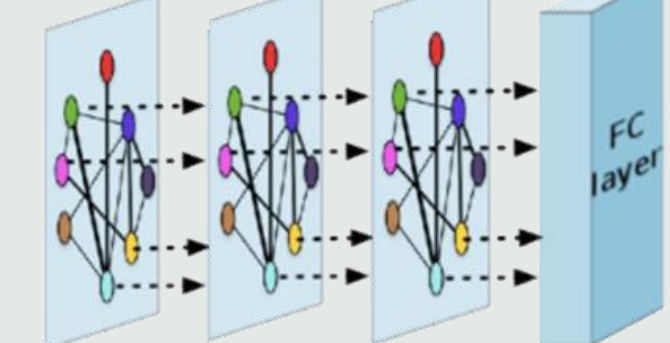
Graph Mining



Graph matching



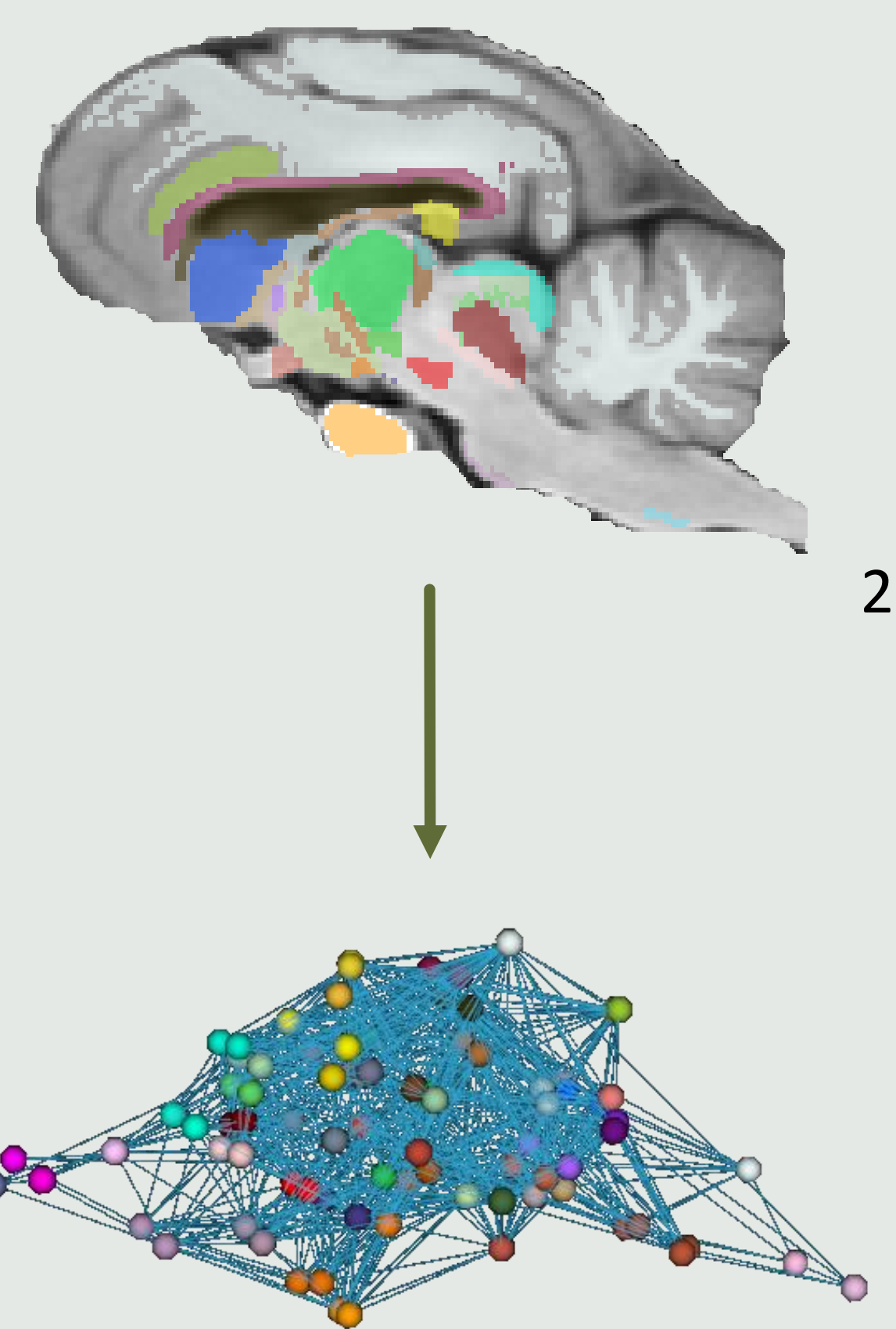
GNN



- Language : python
- Conda environment -> easy to install and use
- Github link : <https://scm.univ-tours.fr/projetspublics/lifat/3dbrainminer>

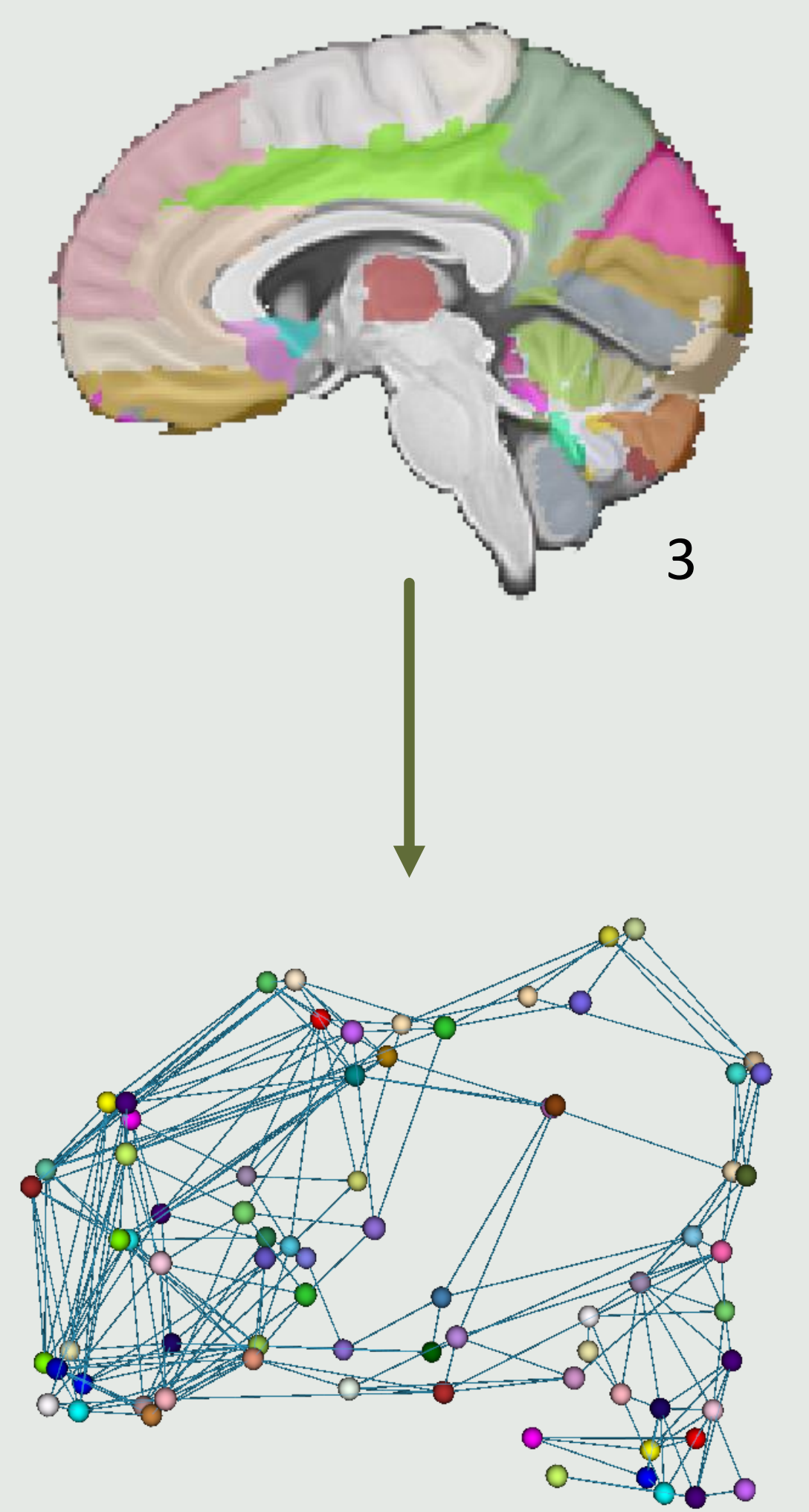
Graphs obtained with 3dBrainMiner :

Sheep brain



2. Musiclamb (Neuro2Co project : <https://hal.inrae.fr/hal-04106607>)

Human brain



3. Yang et al. Neuroimage, 206, 116318.

Original features of 3dBrainMiner:

- A set of interoperable tools (brain segmenter, features extractor, graph builder, graph miner)
- Creation of new features (structure shape, contact surface between structures, radial profile etc.)
- Freedom of adding neuroanatomical knowledge for segmentation, adjacency matrix construction and features creation