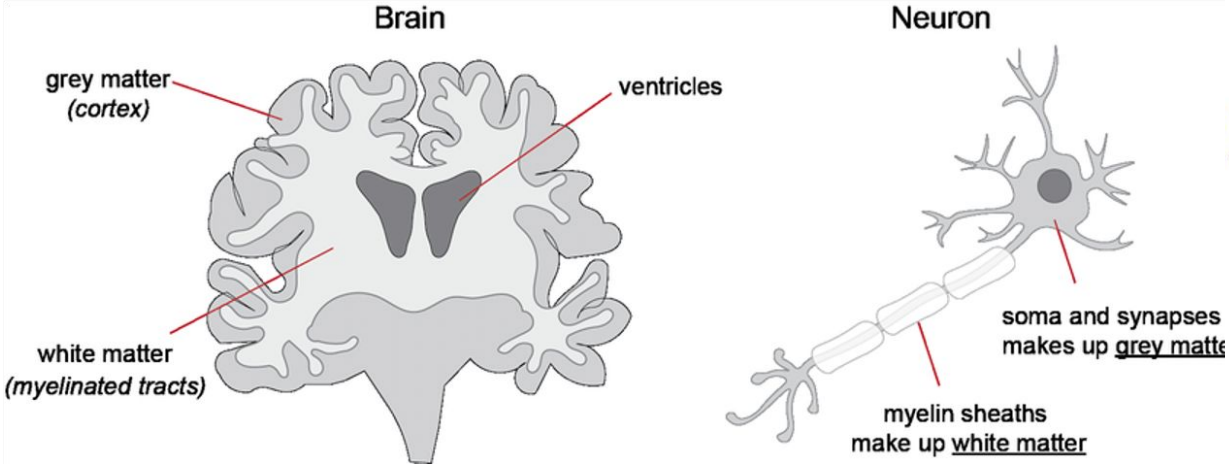
NeuroConnect

Tech review presentation

White Matter



(Madden, 2020)

(O'Donnel & Westin, 2007)

Our data structure

Nodes: coordinates for 57 white matter tracts, each with a start point, end point, and centroid in 3D brain space.

Edges: white matter tracts.

For each tract, we have DTI metrics from ADNI dataset: FA (structural integrity).

What we are building

- **3D network graph** where tracts are edges connecting brain regions
- Interactive brain visualization
- Compare Healthy Controls versus Alzheimer's patients

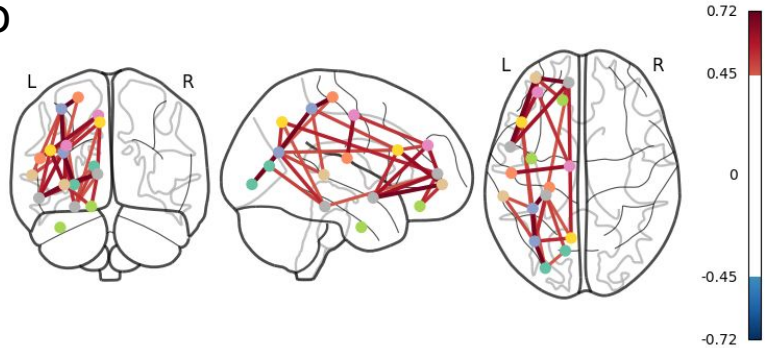
Python visualization library

1. Nilearn
2. NetPlotBrain
3. Plotly

Nilearn

Primarily for machine learning applications but also offers static and interactive plotting functions for neuroimaging data

- Utilizes Matplotlib and Plotly

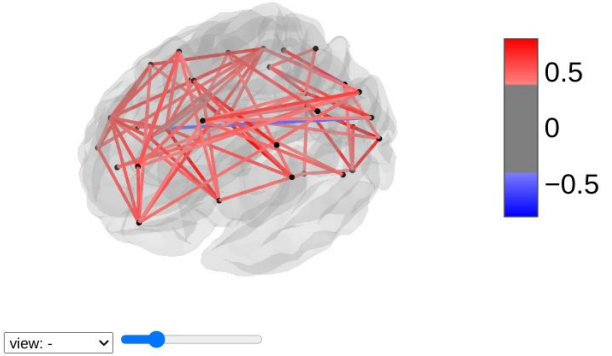


Pros:

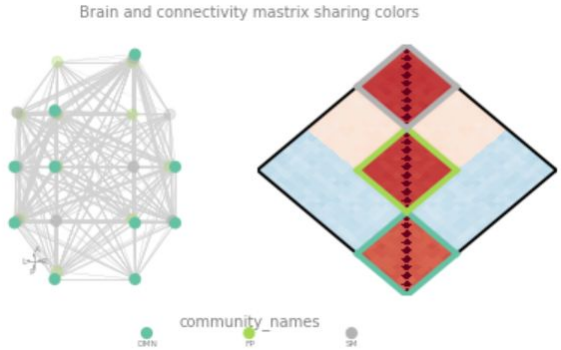
- Weekly drop-in hours with core-developer team
- Detailed documentation

Cons:

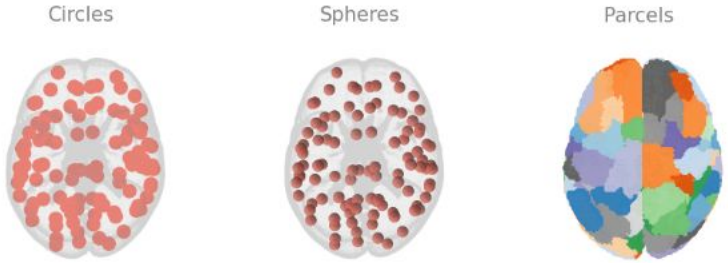
- More focused on functional connectivity
- Requires additional preprocessing steps for our data
- Dependent on multiple packages (e.g. scikit-learn)



NetPlotBrain



- **Static** 3D visualizations of brain images
- Anatomical accuracy
- Inputs:
  - **A template** (a nifty file or a TemplateFlow reference)
  - **Nodes** (Brain regions defined by coordinate pairs (x, y, z))
  - **Edges** (A connectivity matrix representing the brain network structure)



Pros: Easy

Cons: Images are static, hard to show differences between groups, unintuitive connectivity matrices

Plotly

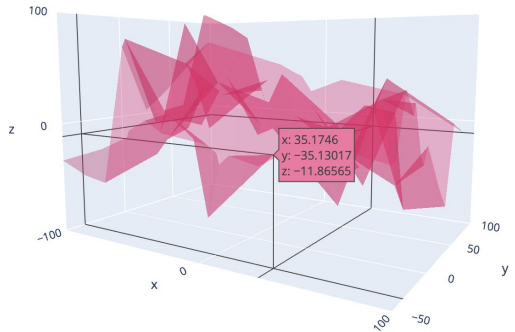
Plotly is a web-native 3D in Python; it integrates cleanly with Shiny for Python; excellent for interactive dashboards with modest mesh sizes.

Pros

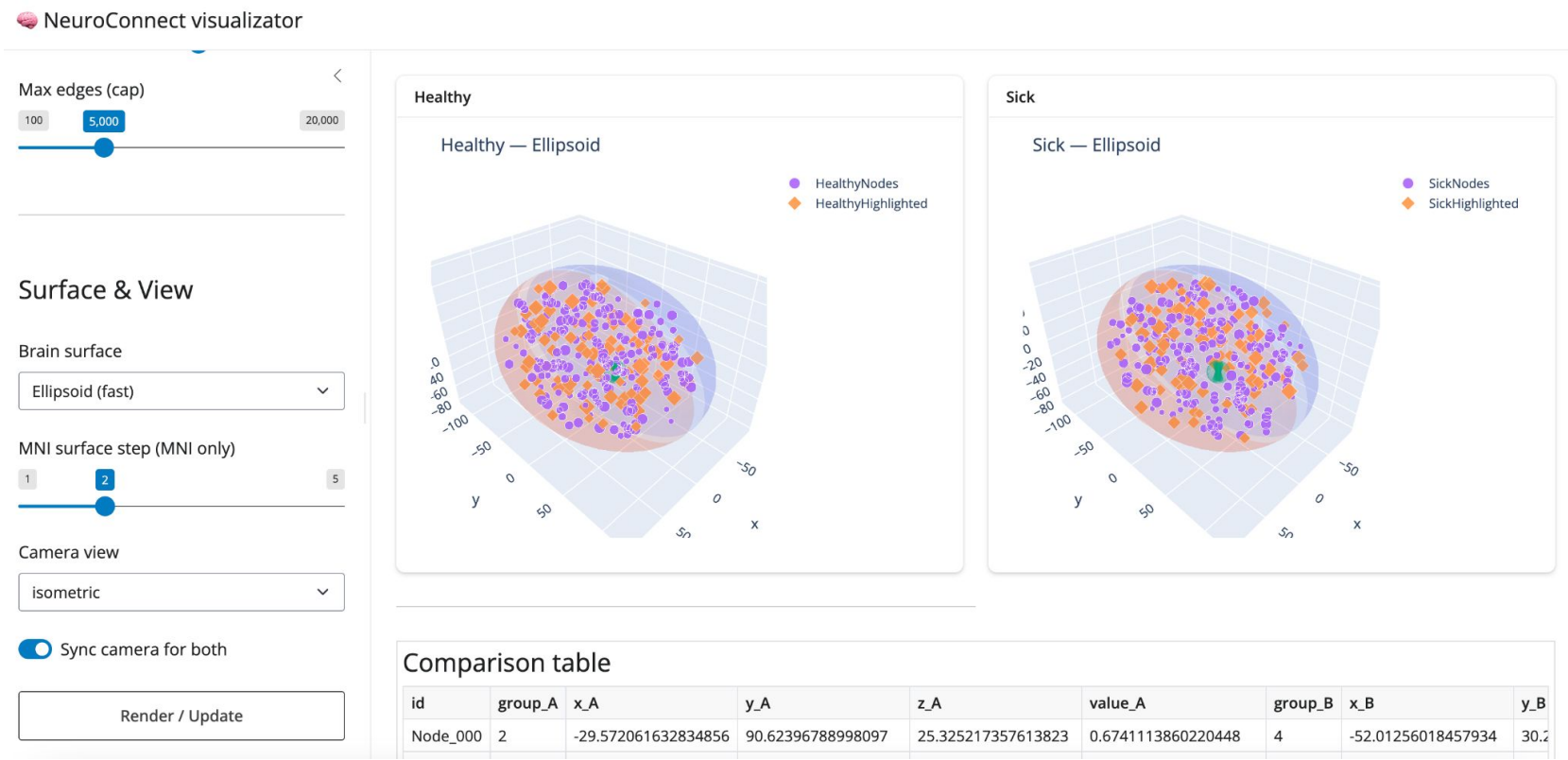
- Works in Shiny for Python
- Interactivity: Hover tooltips, click/selection events, camera control, legends, and colorbars.
- Dev velocity: Simple API; rapid iteration; theming (light/dark) is easy.
- Works with Shiny, Dash, Flask, Jupyter, and static HTML exports.

Cons

- Requires additional preprocessing for neuroimaging data
- For very large meshes/edges or need advanced cortical rendering, we should consider hybridizing with other libraries



Prototype


NeuroConnect visualizator
Max edges (cap)
100
5,000
20,000
Surface & View
Brain surface
Ellipsoid (fast)
MNI surface step (MNI only)
1
2
5
Camera view
isometric
Sync camera for both
Render / Update
Healthy
Healthy — Ellipsoid
HealthyNodes
HealthyHighlighted
Sick
Sick — Ellipsoid
SickNodes
SickHighlighted
Comparison table
id
group_A
x_A
y_A
z_A
value_A
group_B
x_B
y_B
Node_000
2
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4
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