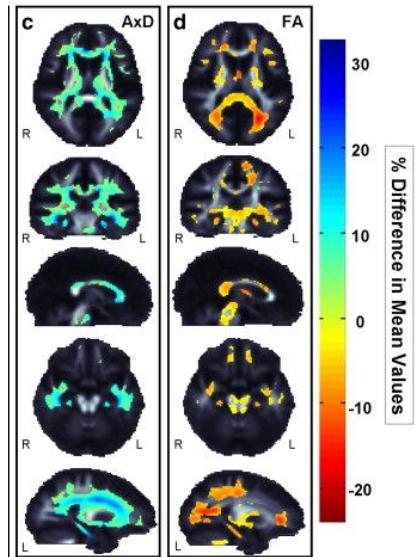
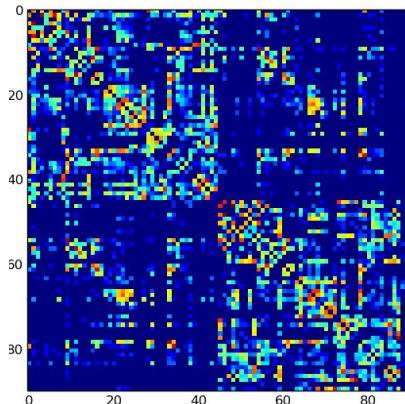


euroConnect

Interactive 3D visualization of structural brain connectivity

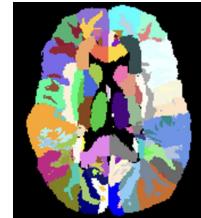
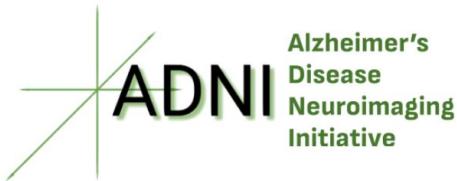
Tina Zhao, Kenny Yi, Carlos Pineda, Hongyu Mu

Background



- ✓ data precision
- ✗ spatial information
- ✓ group differences
- ✗ no 3D
- ✗ how tracts connect
- ✓ anatomically accurate
- ✗ can't compare groups
- ✗ too complex
- ✓ data encoded visually
- ✓ group comparison
- ✓ 3D spatial display
- ✓ accessible

Data Used



- **Diagnosis.csv**
 - Categorical labels per subject (CN vs AD)
- **DTI metrics.csv**
 - FA per tract per subject

Diagnosis	FA_CST_L	FA_CST_R	FA_CGC_L
CN	0.52	0.51	0.48
AD	0.44	0.43	0.41

JHU ICBM-DTI-81 White Matter Atlas.nii.gz

- Extracted MNI coordinates (start, end, centroid) per tract using PCA
- jhu_coordinates.csv

ROI	start_x	start_y	start_z
CST_L	20	21	24
CST_R	17	-30	36
CGC_L	30	-57	9

Limitations

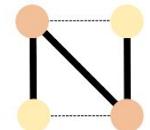
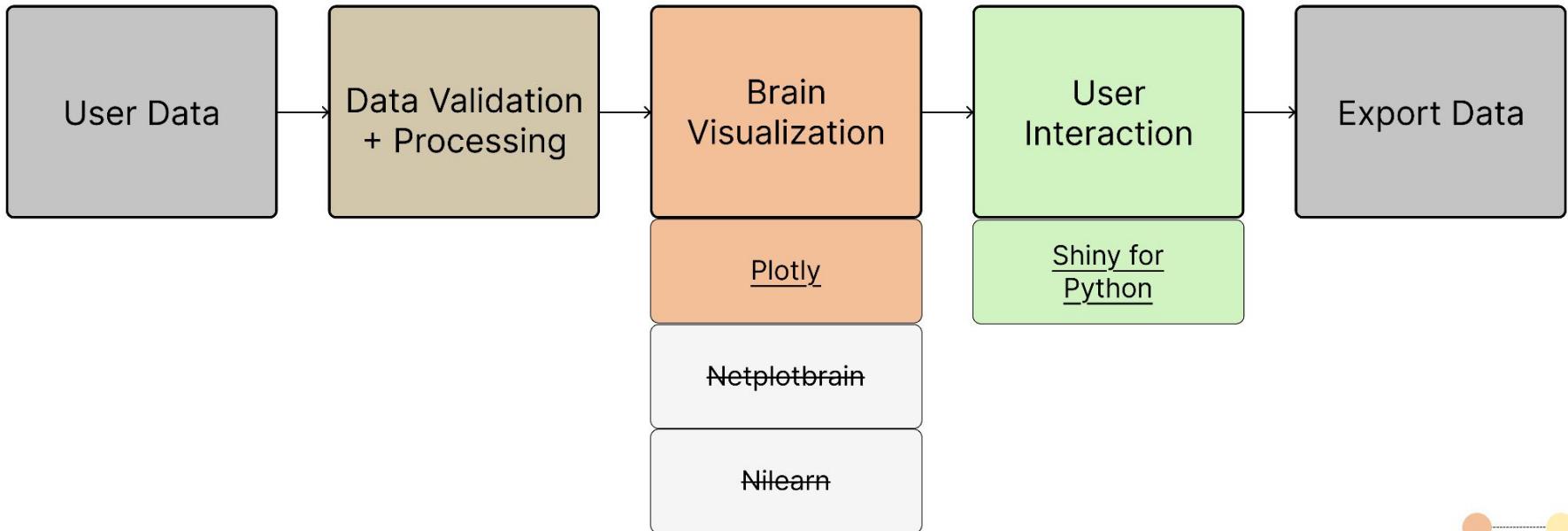
- Individual variability within diagnosis group
- Single time point for subject
- Coordinate simplification
- Summary statistics

Use Cases



1. View brain connectivity
2. Compare brains (CN vs. AD)
- 3. Upload and visualize data**
4. Export brain images
5. Validate Data Quality

NeuroConnect



Data Validation + Processing

1. Data Preparation

= Incomplete

= Finished w/
No Test

= Finished w/
Test

1.1 Data Loading

1.2 Data Cleaning

1.3 Summary Statistics
Calculator

1.4 Summary Data
Output

1.5 Group Difference
Calculator

2. Tract Coordinate Extraction

2.1 Atlas File Locator

2.2 Single Tract
Coordinate Extractor

2.3 Base Tract Loop

2.4 Additional Tract
Calculator

2.5 Coordinate File
Writer

3. Brain Visualization Manager

3.1 Coordinate File
Loader

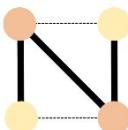
3.2 DTI Metrics Loader

3.3 Node-Edge Mapper

3.4 Edge Value Scaler

3.5 Visualization
Renderer

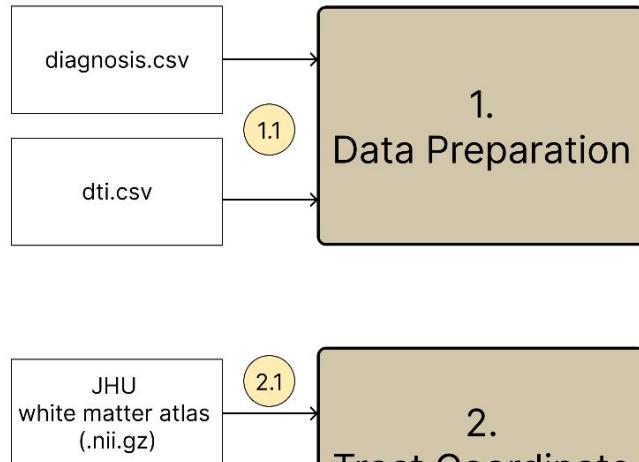
3.6 Comparison
Overlay Visualizer



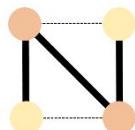
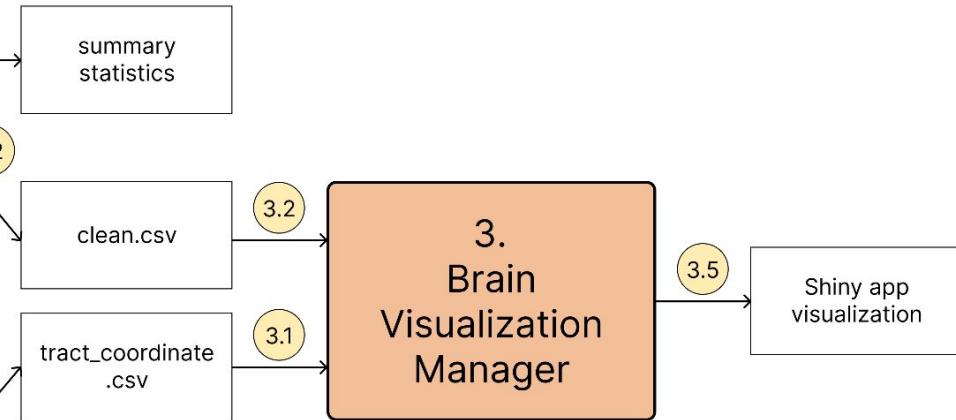


USE CASE: Upload and Visualize Data

Steps 1 & 2: I/O



Step 3: I/O



Project Structure

```
└── LICENSE
└── README.md
└── data
    ├── All_Subjects_DTIROI_MEAN.csv #.gitignore
    ├── All_Subjects_Study_Entry_diagnosis.csv #.gitignore
    └── jhu_coordinates.csv
└── docs
    ├── component_spec.md
    ├── functional_spec.md
    └── environment.yml
└── pyproject.toml
└── requirements.txt
└── src
    └── neuroconnect
        ├── __init__.py
        ├── data_prep.py
        ├── extract_coords.py
        └── visualization_manager.py
└── tests
    ├── __init__.py
    ├── test_data_prep.py
    ├── test_extract_coords.py
    └── test_visualization_manager.py
```

Final product visualization (side by side comparison)

🧠 NeuroConnect



Surface & View

Brain surface

MNI realistic (requires neuro libs)

MNI surface step (MNI only)



Camera view

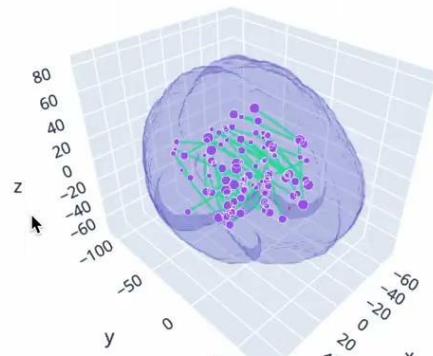
isometric

Sync camera for both

Render / Update

Cognitively Normal (CN)

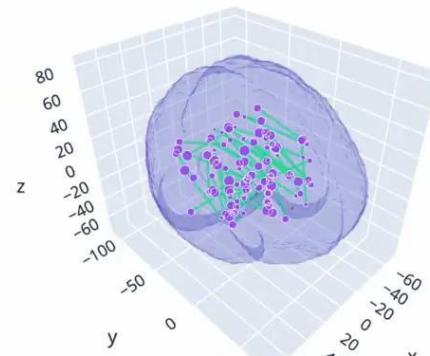
Cognitively Normal (CN) — MNI Realistic Surface



— Edges (52) • Cognitively Normal (CN)Nodes

Alzheimer's Disease (AD)

Alzheimer's Disease (AD) — MNI Realistic Surface



— Edges (52) • Alzheimer's Disease (AD)Nodes

Drag to resize sidebar

Comparison table

Final product visualization (Differential visualization)

NeuroConnect

Use demo (CN)

Use demo (AD)

Load tract data (CN/AD)

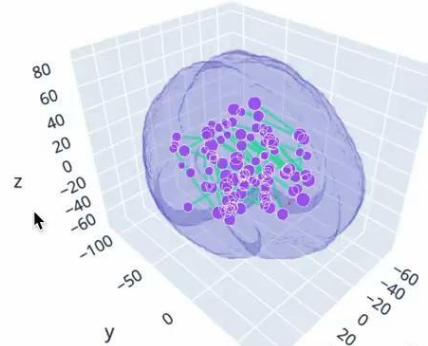
View mode

Mode

Side-by-side

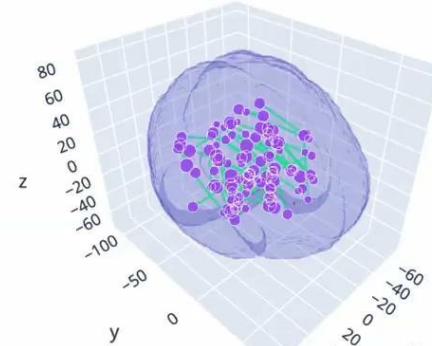
Cognitively Normal (CN)

Cognitively Normal (CN) — MNI Realistic Surface



Alzheimer's Disease (AD)

Alzheimer's Disease (AD) — MNI Realistic Surface



Highlighting & AOI

IDs to highlight

Comparison table

Lessons learned

- **More lenient lint/format, focus on actual tests first.** Import order and line-length churn burned time; auto-format + pre-commit saves reviews for logic
- **Continuous Integration Automation.** So that the configurations are not only “working on my machine” but tested in a neutral environment
- **Single, atomic units of pull requests.** Reducing load on reviewers
- **Define interfaces and inputs/outputs early on.** Prevent potential front-end UI and backend data mismatch
- **Testing early will save time late.** We don’t write test for today, we write tests so in the future we can refactor without fear.
- **Thinking in terms of user stories.** It centers the user experience and forces clarity on the problem we are solving.

Future Work

- Integration with standard neuroimaging formats (NIfTI, GIFTI, CIFTI)
- Add statistical comparison tools
- Work on continuous integration for catching breaking changes early
- Ensures consistency behavior across machines, OS, and environments
- Finalize the complete work pipeline (i.e connecting data prep, tract coordinate extraction and visualization modules)