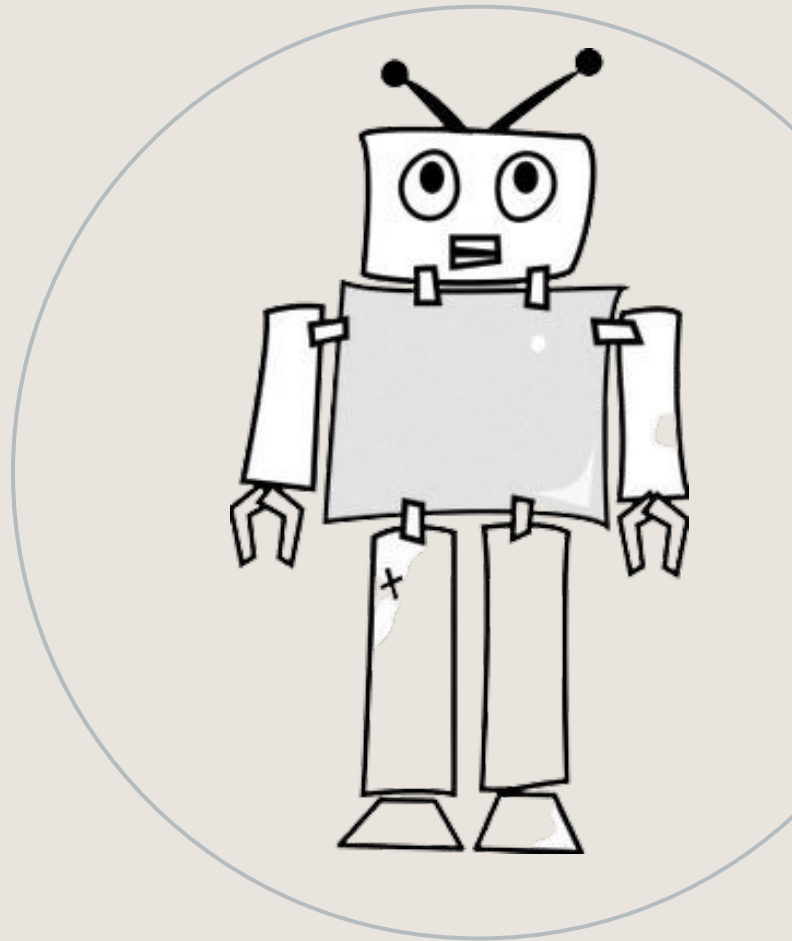


Net2Brain

A Toolbox to compare artificial
vision models with human brain
responses

Prof. Dr. Gemma Roig
M.Sc. Domenic Bersch



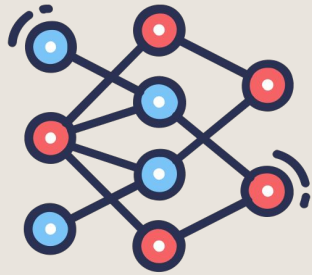


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Background

What is the background of our research?

The Evaluation of Underlying Cortical Mechanisms and Functions using Artificial Models is Popular



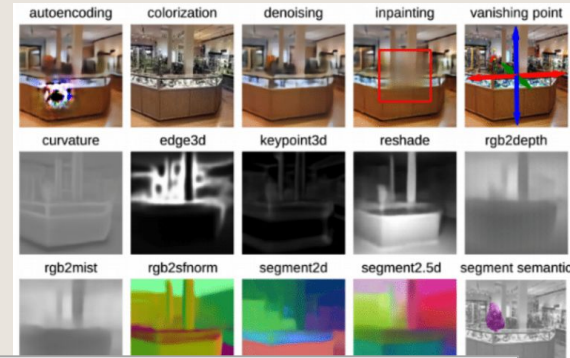
The Background



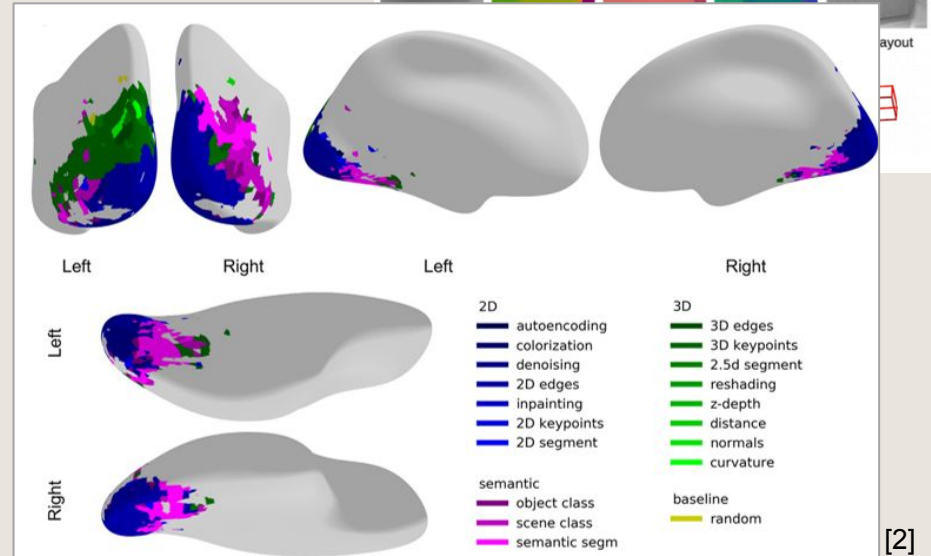
State-of-the-art Computational Cognitive Models:
 Training DNNs for visual tasks enables mimicking, predicting and explaining visual cortex activity.



Uncovering Brain Mechanisms:
 Analyzing model responses reveals computational and functional characteristics of distinct brain areas.



[1]



[2]

[1] <https://github.com/StanfordVL/taskonomy>

[2] Dwivedi K, Bonner MF, Cichy RM, Roig G. 2021. Unveiling functions of the visual cortex using task-specific deep neural networks. *PLOS Comput. Biol.* 17(8):e1009267

Why is there a need for Net2Brain?



Rapid pace of advancements:
Fast development of DNNs and metrics for evaluation



Reproducibility and Transparency:
Experiment replication is challenging without an existing baseline.



Time-intensive Work:
Manually implementing algorithms can be time-consuming.



Specialization of Existing Tools:
Interchangeability enabling enhancement of other specialized toolboxes



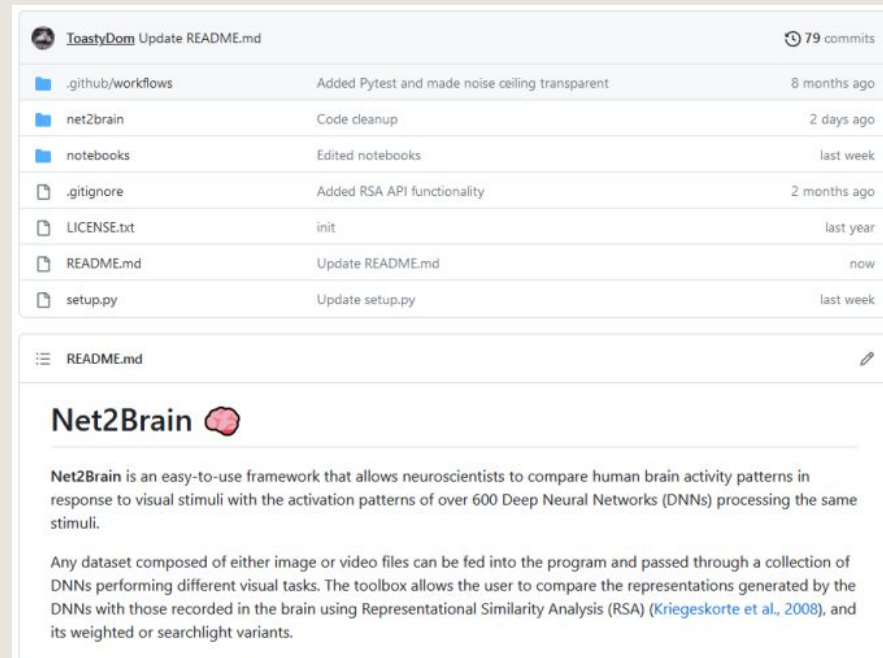
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Net2Brain

Introduction to our Toolbox

Net2Brain

- **Comprehensive PyTorch Library:** Facilitating neural research with deep neural networks.
- **Time-Saving Toolbox:** Providing an all-in-one solution with 600+ pretrained neural networks for diverse applications and enhanced human-like AI performance.
- **Uncovering Computational Principles:** Encouraging research alignment between deep neural networks and human brain activity.
- **Interdisciplinary Collaboration:** Empowering non-CS neuroscientists and fostering collaboration across fields for scientific advancements.



The screenshot shows a GitHub repository for 'Net2Brain' by user 'ToastyDom'. The commit history table is as follows:

File	Commit Message	Time
.github/workflows	Added Pytest and made noise ceiling transparent	8 months ago
net2brain	Code cleanup	2 days ago
notebooks	Edited notebooks	last week
.gitignore	Added RSA API functionality	2 months ago
LICENSE.txt	init	last year
README.md	Update README.md	now
setup.py	Update setup.py	last week

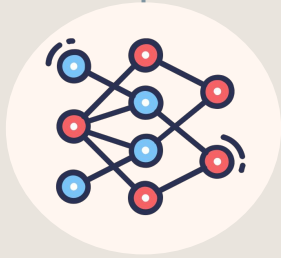
The README content is as follows:

Net2Brain

Net2Brain is an easy-to-use framework that allows neuroscientists to compare human brain activity patterns in response to visual stimuli with the activation patterns of over 600 Deep Neural Networks (DNNs) processing the same stimuli.

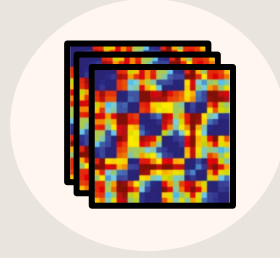
Any dataset composed of either image or video files can be fed into the program and passed through a collection of DNNs performing different visual tasks. The toolbox allows the user to compare the representations generated by the DNNs with those recorded in the brain using Representational Similarity Analysis (RSA) (Kriegeskorte et al., 2008), and its weighted or searchlight variants.

Net2Brain: Key Functions



1. Feature Extraction

- Feature extraction of 600+ pretrained/random neural networks
- Image/Video/Text Data
- Dimensionality reduction
- Option to add custom model/processor/extractor



2. Creating RDMs

- Representational Dissimilarity Matrices (RDMs)
- Multitude of distance metrics
- Option to add custom metrics
- Creation from DNN and raw EEG data
- RDM visualization



3. Evaluation + Plotting

- Representational Similarity Analysis (RSA),
- Weighted RSA,
- Searchlight evaluation
- Linear Encoding Models
- Variance Partitioning Analysis
- Visualization of results



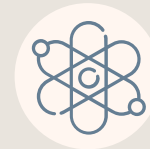
Open Framework

- Model-Taxonomy for informed model selection
- Access to 600+ models trained for various tasks
- Image/Video/Text Data
- Comprehensive evaluation including noise ceilings and neural activation prediction.



Interchangeability

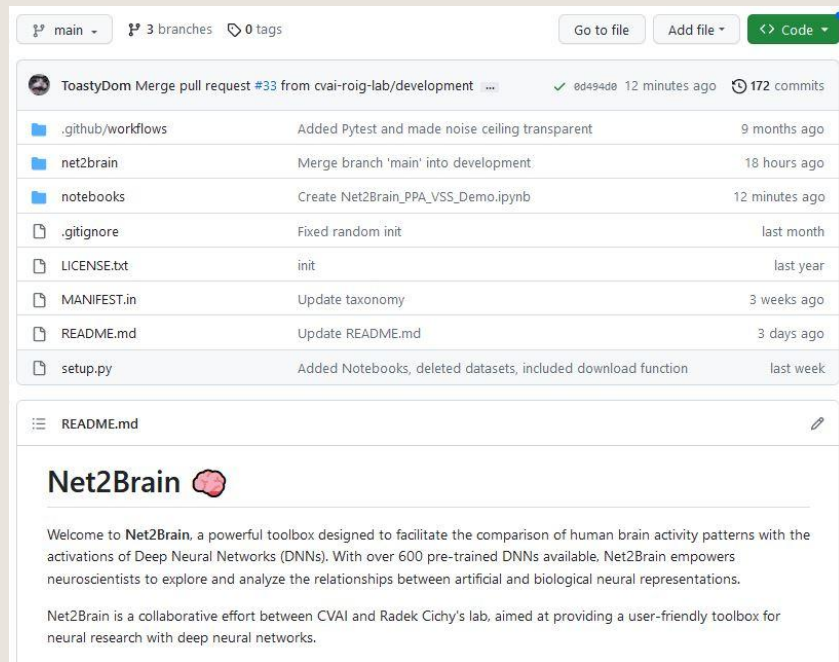
- Complements and extends existing toolboxes rather than attempting to replace any
- Modular design for flexible integration



Interface for neural research

- Tailored interfaces for the NSD and THINGS datasets
- Simplified data handling and analysis processes

Available on GitHub!



The screenshot shows the GitHub interface for the repository 'cvai-roig-lab/Net2Brain'. At the top, it indicates the current branch is 'main', there are 3 branches, and 0 tags. Navigation buttons for 'Go to file', 'Add file', and 'Code' are visible. A merge pull request #33 from 'cvai-roig-lab/development' is shown, merged 12 minutes ago with 172 commits. A file list includes: .github/workflows (Added Pytest and made noise ceiling transparent, 9 months ago), net2brain (Merge branch 'main' into development, 18 hours ago), notebooks (Create Net2Brain_PPA_VSS_Demo.ipynb, 12 minutes ago), .gitignore (Fixed random init, last month), LICENSE.txt (init, last year), MANIFEST.in (Update taxonomy, 3 weeks ago), README.md (Update README.md, 3 days ago), and setup.py (Added Notebooks, deleted datasets, included download function, last week). Below the file list, the README.md content is displayed, featuring the 'Net2Brain' logo with a brain icon and a welcome message.

main 3 branches 0 tags Go to file Add file Code

ToastyDom Merge pull request #33 from cvai-roig-lab/development ✓ 0d494d0 12 minutes ago 172 commits

..github/workflows	Added Pytest and made noise ceiling transparent	9 months ago
net2brain	Merge branch 'main' into development.	18 hours ago
notebooks	Create Net2Brain_PPA_VSS_Demo.ipynb	12 minutes ago
.gitignore	Fixed random init	last month
LICENSE.txt	init	last year
MANIFEST.in	Update taxonomy	3 weeks ago
README.md	Update README.md	3 days ago
setup.py	Added Notebooks, deleted datasets, included download function	last week

☰ README.md ✎

Net2Brain

Welcome to **Net2Brain**, a powerful toolbox designed to facilitate the comparison of human brain activity patterns with the activations of Deep Neural Networks (DNNs). With over 600 pre-trained DNNs available, Net2Brain empowers neuroscientists to explore and analyze the relationships between artificial and biological neural representations.

Net2Brain is a collaborative effort between CVAI and Radek Cichy's lab, aimed at providing a user-friendly toolbox for neural research with deep neural networks.



<https://github.com/cvai-roig-lab/Net2Brain>

Future of Net2Brain

- Including Audio Models
- Adding CKA as a new similarity measure
- More example notebooks
- Getting community input and incorporate it into the toolbox



Other great Toolboxes

- **THINGScore**: A Python Toolbox for Streamlining the Extraction of Activations From Deep Neural Networks [1]
- **RSAToolbox**: A Toolbox for Representational Similarity Analysis [2]
- **BrainScore**: Which Artificial Neural Network for Object Recognition is most Brain-Like? [3]
- **TorchLens**: Extracting and visualizing hidden activations and computational graphs of PyTorch models with TorchLens [4]



[1] Muttenthaler L, Hebart MN. (2021) THINGSvision: A Python Toolbox for Streamlining the Extraction of Activations From Deep Neural Networks. *Frontiers in Neuroinformatics* 15: 679838. <https://doi.org/10.3389/fninf.2021.679838>

[2] Nili H, Wingfield C, Walther A, Su L, Marslen-Wilson W, et al. (2014) A Toolbox for Representational Similarity Analysis. *PLoS Computational Biology* 10(4): e1003553. <https://doi.org/10.1371/journal.pcbi.1003553>

[3] Martin Schrimpf, Jonas Kubilius, Ha Hong, Najib J. Majaj, Rishi Rajalingham, Elias B. Issa, Kohitij Kar, Pouya Bashivan, Jonathan Prescott-Roy, Kailyn Schmidt, Daniel L. K. Yamins, James J. DiCarlo bioRxiv 407007; doi: <https://doi.org/10.1101/407007>

[4] Taylor, J., Kriegeskorte, N. Extracting and visualizing hidden activations and computational graphs of PyTorch models with TorchLens. *Sci Rep* 13, 14375 (2023). <https://doi.org/10.1038/s41598-023-40807-0>

Who are we?



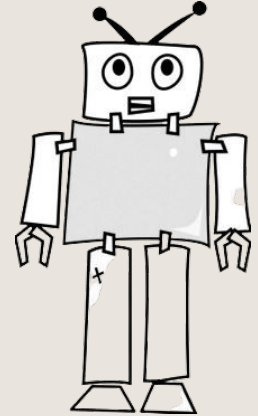
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Dr. Kshitij Dwivedi

Past collaborator



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**Thanks for
listening!**

