

Deep neural nets & EEG brain representations

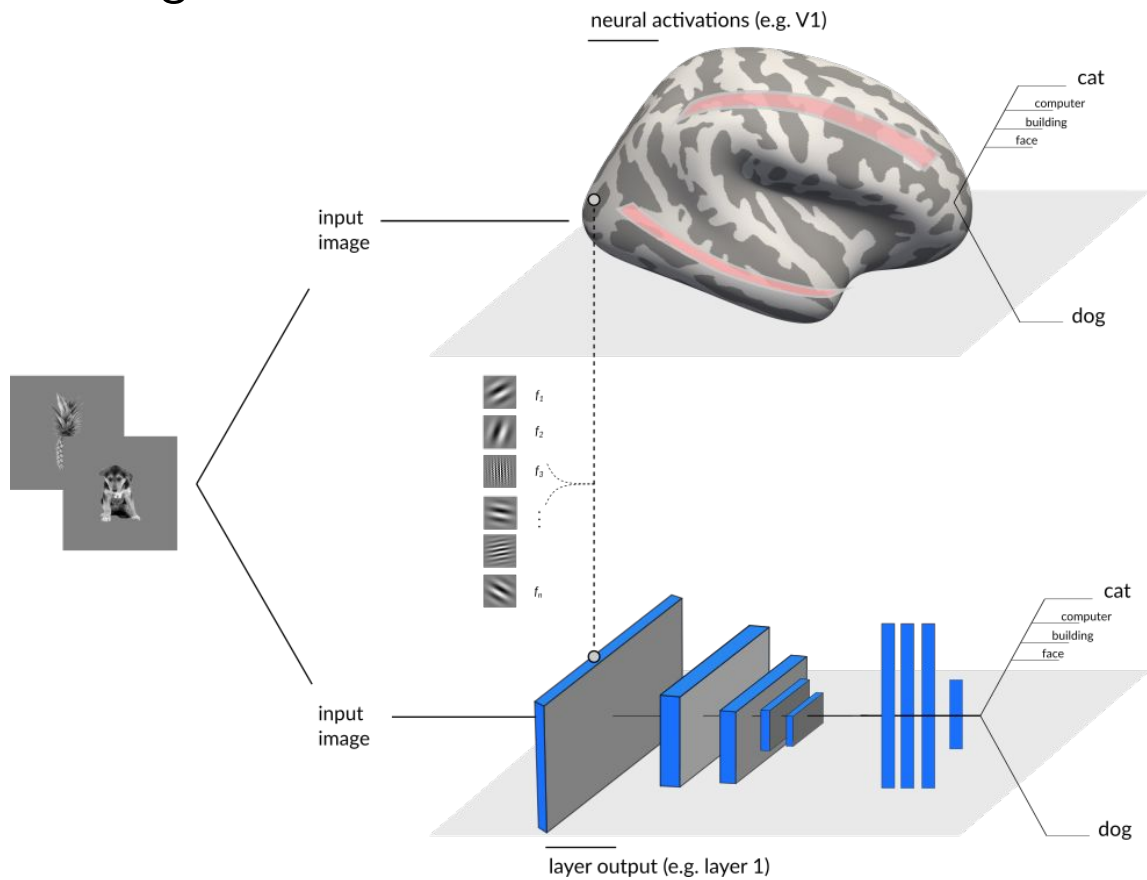
Brain hack school 2020
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UNIVERSITY OF
BIRMINGHAM

Université 
de Montréal

Background



Visual brain

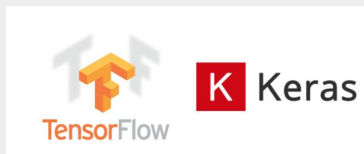
Deep neural networks

Goals

Compare brain and DNN representations
(and learning cool new tools while doing so)



1. Main scripts (analysis)



2. visualization



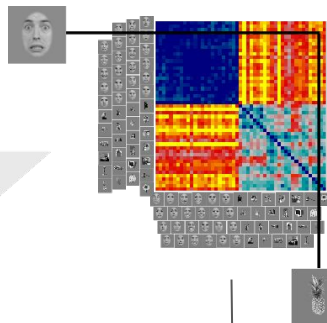
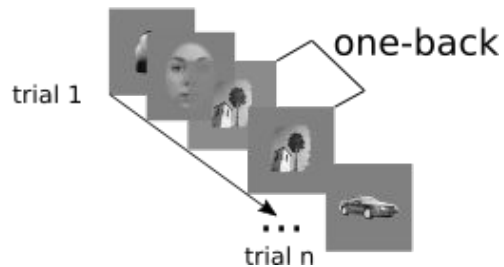
Dataset

EEG patterns

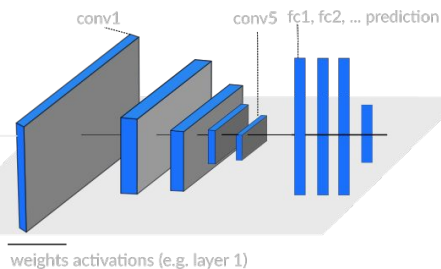


RSA
"decoding"

N=23
(>72,000 repetitions)



Representational Dissimilarity Matrices



Fantastic scripts (and where to find them)

Analysis pipeline

1. Import & format human EEG data
2. Choose/create DNN, format images to be “fed” as input.
3. Create DNN RDMs:
 - a. extract layer outputs per image.
 - b. compute pairwise dissimilarity.
4. Compare brain & DNN data
5. Useful functions

scripts.py

import_check_eeg.py

modelisation_vgg.py

link_brain_dcnn.py

helpful_functions.py

Fantastic scripts (and where to find them)

Visualization

[scripts.ipynb/py](#)

1. Interactive visualization of EEG-RDMs data

[interactive_figures_EEGxRSA.ipynb](#)

2. Deep neural net RDMs & predictions examples

[modelisation_vgg.py](#)

3. Time course Brain x DNN similarity

[link_brain_dcnn.py](#)

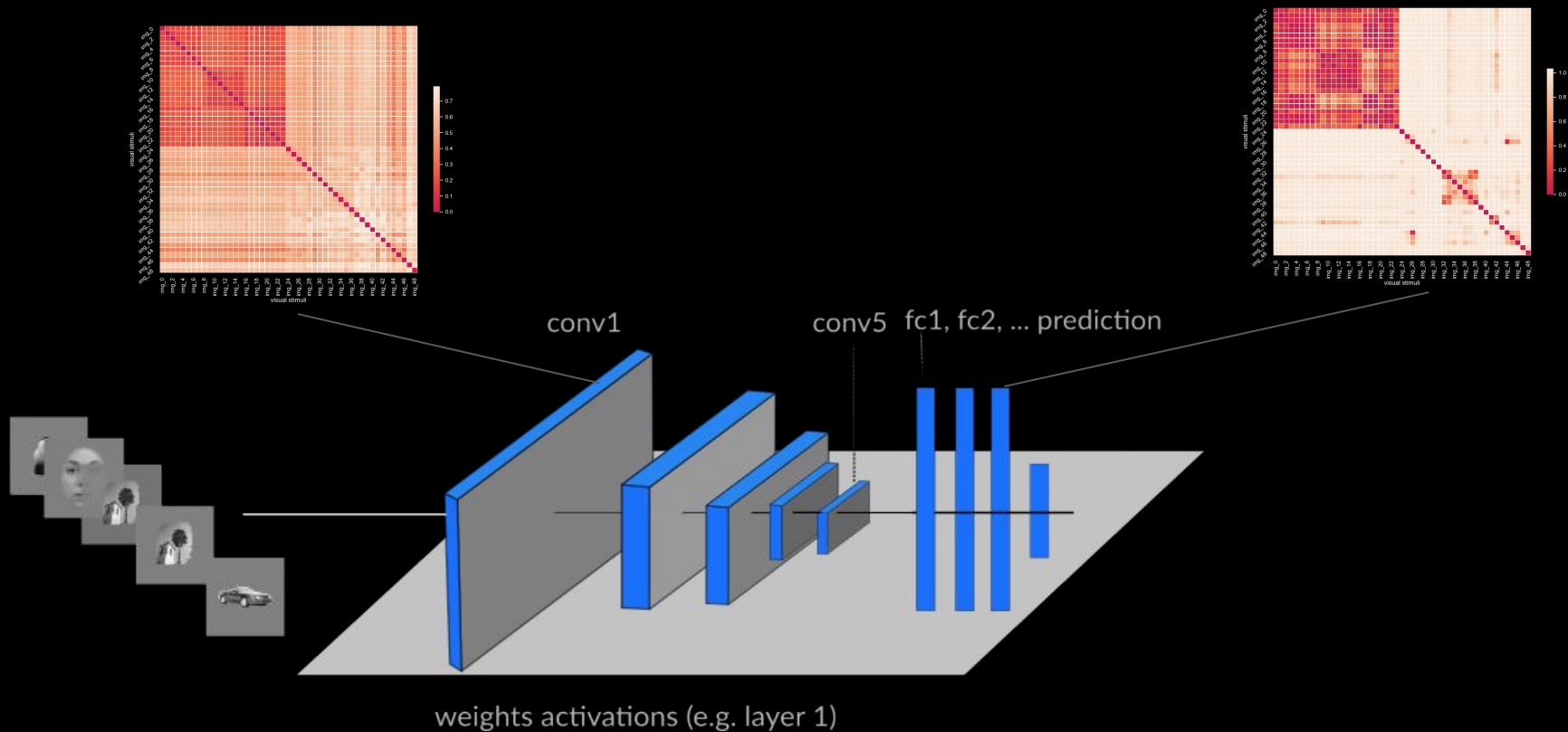
Results & data visualization

interactive_figures_EEGxRSA.ipynb

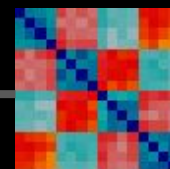
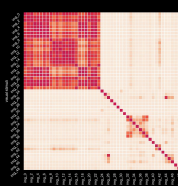
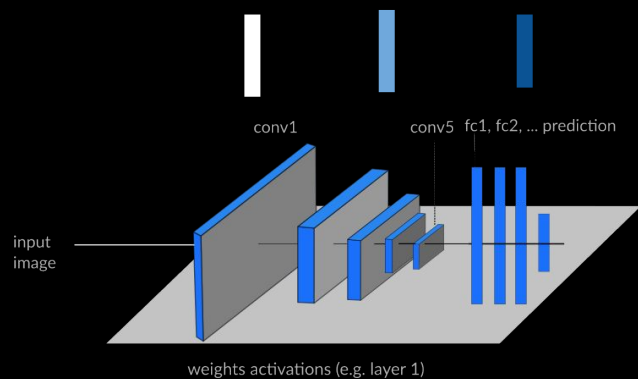
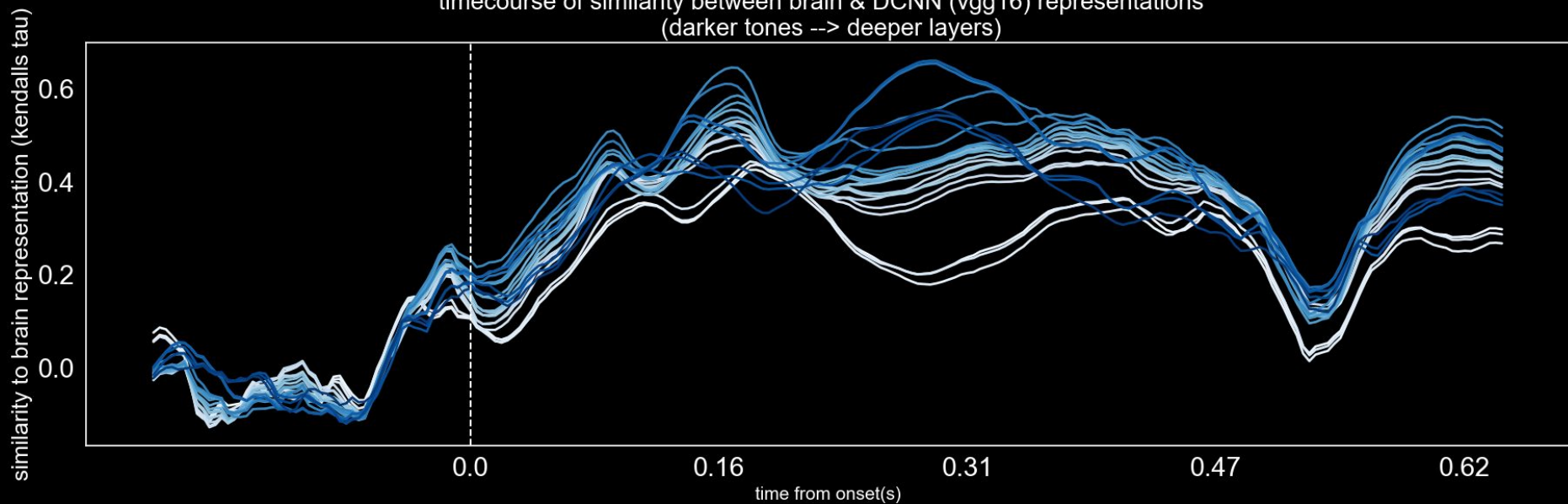


How VGG16 encodes visual images

(modelisation_vgg.py)



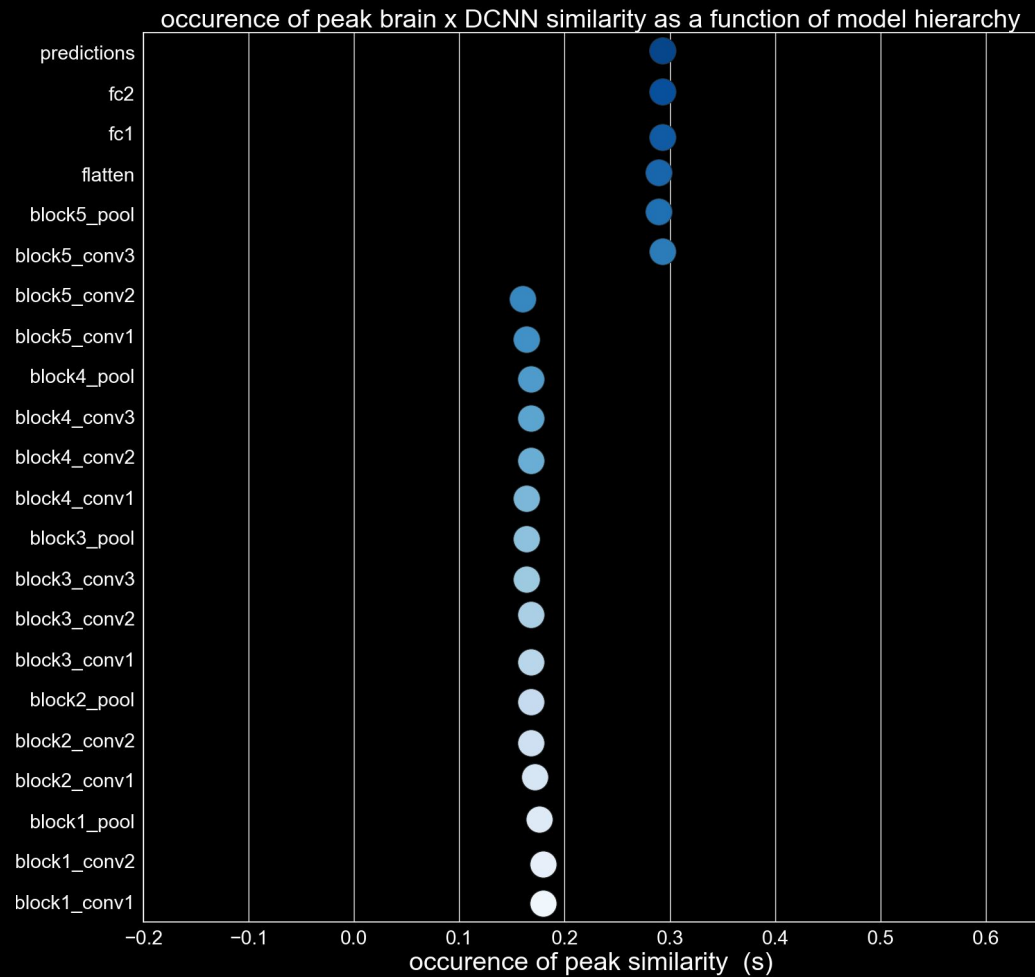
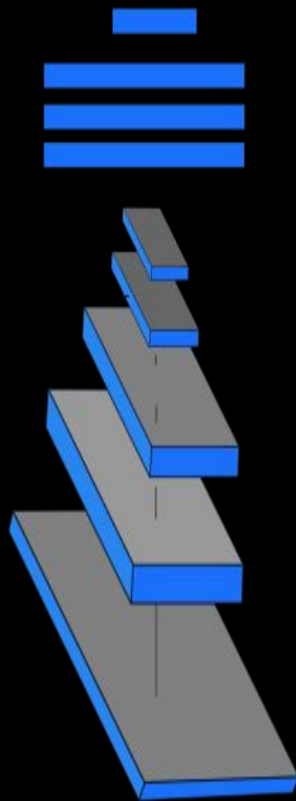
timecourse of similarity between brain & DCNN (vgg16) representations
(darker tones --> deeper layers)



Time t
Kendall's tau



Deeper layers



Tools I used before,

- Mostly **MATLAB**
 - analysis (fieldtrip, MVPA-light)
 - data visualization
 - experiments
- some GitHub, bash
- Inkscape & Illustrator

tools I worked with here

- Many flavors of Python
- Flexible data visualization tools
- Jupyter Notebooks
- Deep learning & integrating brain and DNN outputs
- bash & markdown
- Learn to better share science
- Developing good (better) coding practices..
 - GitHub
 - Cleaner & clearer code

Future goals

Short term:

- Recode preprocessing & decoding of EEG data in Python.
- Sharing science with new data visualization tools. (e.g. VSS-online conference)

Develop flexible tools for the lab..

- Automatic pipeline to link brain signal and DNN architecture
- BIDS-like psychophysics data : “Reverse Correlation Data Structure” (ReCorDS)

**BrainHack
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2020**

Thanks everyone!!

