

# Visual encoding and decoding with BOLD5000 dataset

Cognitive Science and AI: Assignment 4

April 7, 2024

## 1 Instructions for submission

Maximum marks - 50

**Deadline: 8th April 2024**

- You may do the assignment in Jupyter or Colab notebook or a script that executes the code.
- A report should be submitted that includes all the deliverables. Report and code should be included in a folder specified by Roll Number and Name of the student and submitted in Moodle, adhering to the deadline.
- Include the assignment number, your name and roll number in the notebook/script as well for better identity.
- Late submissions are NOT accepted.
- IMPORTANT: Make sure that the assignment that you submit is your own work. Do not copy any part from any source including your friends, seniors. Any breach of this rule could result in serious actions including an F grade in the course.
- Your marks will depend on the correctness / convincing discussion points. In addition, due consideration will be given to the clarity and details of your answers and the legibility and structure of your code.
- Do not copy or plagiarise, if you're caught for plagiarism or copying, penalties are much higher (including an F grade in the course) than simply omitting that question.

## 2 Objectives

This assignment is based on the BOLD5000 dataset which includes fMRI responses for three subjects viewing 4916 unique images drawn from ImageNet, COCO, and SUN.

This assignment outcome focuses on visual image encoding to fMRI responses and decoding visual stimuli given fMRI responses given each of the ROI in Early Visual, LOC, OPA, PPA, RSC. The idea is to train regression models that map stimulus set of images to fMRI data to predict brain activity in each of the ROI.

- Use Pretrained ResNet18 (up to final fully-connected projection layer) for extracting image features
- Uses open source BOLD5000 fMRI data as target data.

### 3 Regions of Interest (ROIs)

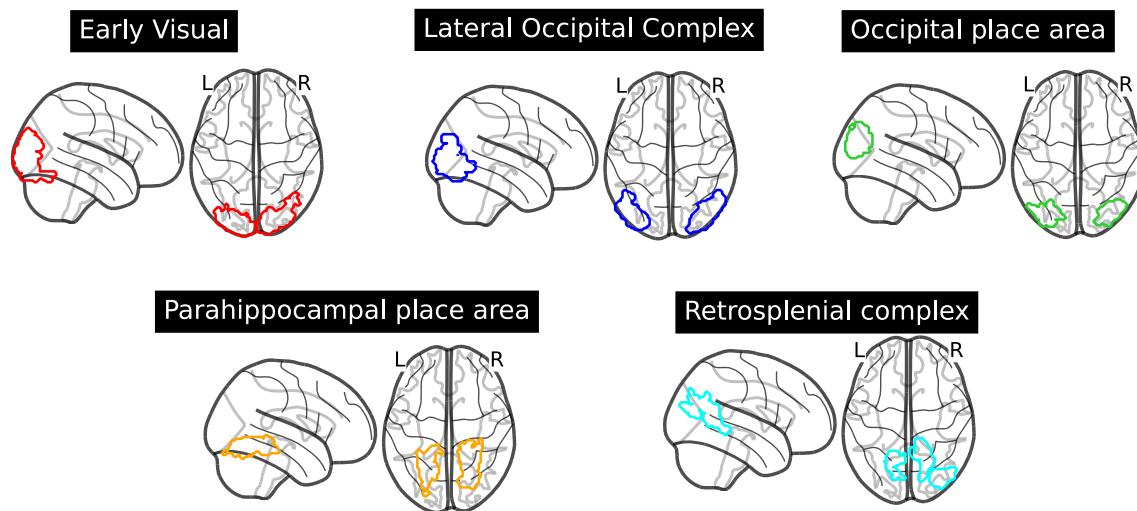


Figure 1: Different ROIs in the Ventral Visual system potentially participating in the representation of different categories of objects

### 4 fMRI Dataset

BOLD5000 dataset

### 5 Tasks

Implement regression models that predict fMRI responses to visual stimuli set. Decode the reverse inference process.

### 6 Deliverables

A brief report and code should be submitted. More weightage in marks will be given for convincing discussion for each figure. Code can be submitted as a separate script or notebook that generate the figures included in the report.

#### A Which dataset to choose?

You can work on this fMRI data which has data from each ROI pre-extracted.

More details can be found in this Readme document. Specifically look for "DATA DESCRIPTION FOR: BOLD5000\_ROIs.zip"

Briefly, it has 4 subjects. You can choose any one subject for this assignment.

## B In each subject we have multiples files, which one to choose?

Depending upon your comfortability, choose either .mat or .h5. The filename that has "TR34" should be picked.

For e.g., filename "CSI1\_ROIs\_TR34.mat" is for subject 1 and it contains data pre-extracted from each of the 5 ROIs as listed in Figure 1.

### **Important**

4916 stimuli images have been presented to each subject from all ImageNet, COCO and Scene combined.

As mentioned in the Readme Note that for CSI1, 2, 3 the # of images viewed is 5254. For CSI4 the # of images viewed is 3108 example:

For CSI1 'LHPPA' Matrix is of shape 5254 x 157 (total number of images seen with repetition x number of voxels in ROI)

The ordering of images are provided in stim\_lists folder. CSIX\_stim\_lists.txt provided the 5254 ordering of image names.

**An image was viewed multiple times by a subject, please include/choose those fMRI data signals with respect to the first-presented image. This should count to dimension 4916 unique images without repetition.**

So, in conclusion, the fMRI data features set should have (4916 x number of voxels in ROI) in order to be compliant with the activations extracted with pre-trained RestNet18 model trained on 4916 images.

Hope this helps!!