Analyzing the role of multiple cortical ROIs during visual object recognition

Cognitive Science and AI: Assignment 3

March 12, 2024

1 Instructions for submission

Maximum marks - 50

Deadline: 22nd March 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 fMRI data recorded while participants viewed a set of 92 different objects categorized into "human bodypart", "human face", "nonhuman bodypart", "nonhuman face", "natural inanimate", "artificial inanimate" as shown on Figure 1. Note that the fMRI volume acquired was limited to a slab covering the Occipital and Temporal cortex. This revealed the spatial dynamics of information flow in ventral visual cortex. The objective

is to analyze the brain representation of different categories predicted from fMRI statistical maps.

The assignment outcome is focused on multi-category classification and visualization of the predictive patterns of representation, displayed on the brain to analyze the recruitment of different ROIs (Figure 2) for different object categories.

Figure 1: fMRI responses are captured for 15 participants while viewing 92 different objects.

3 Regions of Interest (ROIs)

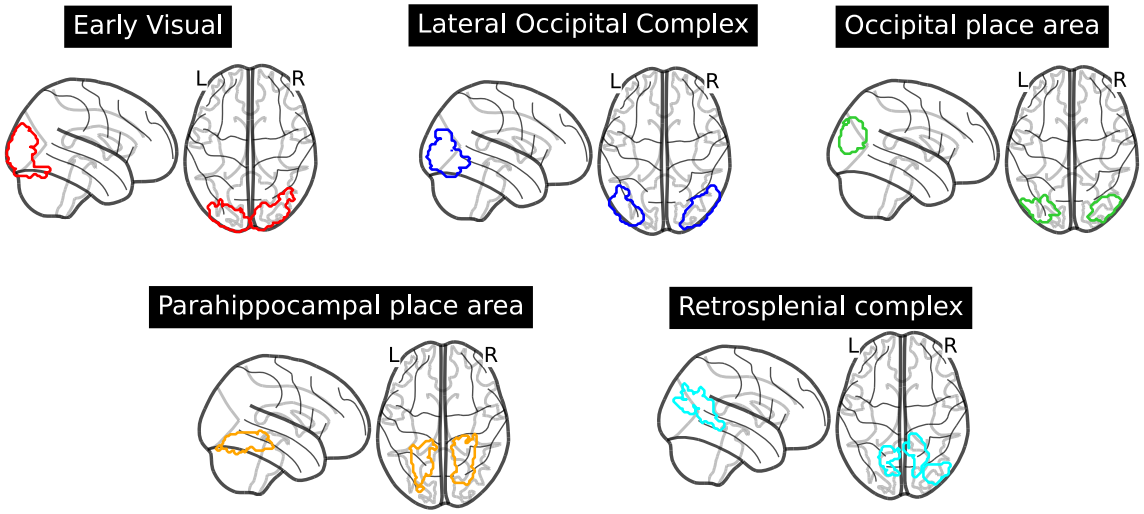

Figure 2: Different ROIs in the Ventral Visual system potentially participating in the representation of different categories of objects

List of ROIs can be found on this link

4 fMRI Dataset

Dataset can be downloaded from this link

5 Tasks

On a single subject, implement multi-class classification model that simultaneously decodes multi-objects given the fMRI statistical maps of various ROIs. Creatively visualize the spatial distribution of classification weights on the brain ROIs. Analyze the overlapping patterns of weights corresponding to the given ROIs for each of the categories in the multi-class classification problem framework and any functional specializations emerging for different ROIs.

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.