

Neuroengineering 2023-2024
September 10th, 2024
Part II

How to submit your answers.

The answers can be typed in the provided text file, following the template. Do not modify or move the lines containing the headers.

Textual answers must be typed in the editor. When graphical elements are required in the answer, the latter can be written on paper.

Keep your answers tidy. Messy, hard-to-read answers may penalize your mark.

The maximum total score for part II is **8**.

Carefully read the following scenario and answer the questions listed below.

The objective of this study is to assess the impact of **a novel pharmacological intervention** on the organisation of **functional brain networks** associated with lower limb **motor function** in patients with **multiple sclerosis** (MS).

The patients are divided into two groups. The first one, designated as the '**experimental group**', receives the novel therapeutic intervention, whereas the second one, termed as the '**control group**', is treated with the conventional therapy. The duration of intake is identical for both groups and lasts for a period of three months.

It is checked that the functional networks of both groups exhibit **comparable characteristics** at the **beginning** of the therapy.

At the conclusion of the intake period the brain signals of the two groups of patients are acquired during a **motor task** involving the lower limb. This task is known to induce activity and connectivity between cortical areas in the **alpha** and **beta** bands.

Due to the complexity of the task and the clinical condition of the patients, only **a limited number of trials** could be acquired.

The objective of the study is to **compare** the brain connectivity networks obtained for the two groups of patients by analysing some of their properties described by indices derived from graph theory, to determine **whether the drug therapy** being evaluated induces a **different brain organisation** than **conventional therapy**.

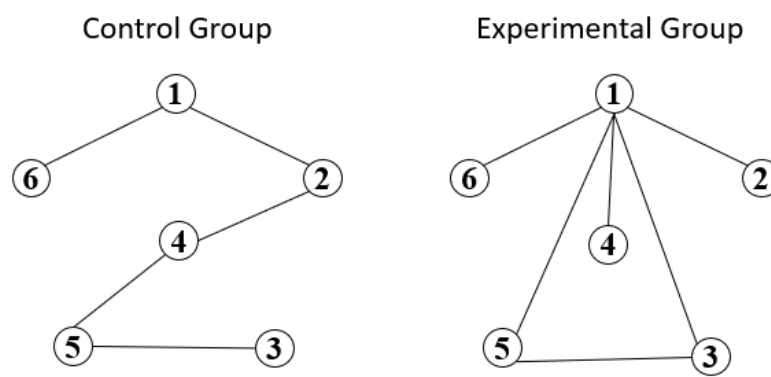
Questions

Write all your answer in the provided text file

Q1. Indicate which **estimator** you would choose to **evaluate functional connectivity**. **Justify your choice**, stating its advantages and disadvantages in relation to the specific scenario (3 points)

N.B.: The reasons for the choice should not be based on the networks shown in the following figure.

Q2. Assuming that the two networks shown in the following figure are obtained for **alpha band**, for the **control group** (left) and the **experimental group** (right):



Q2.1: For each group, compute the degree of each node (1 point)

Q2.2: For each group, compute the Local Efficiency E_i (3 points)

Q3. Given the results obtained in Q2, please indicate in which of the two groups (Control or Experimental) the network has a greater tendency to form subgroups of strongly connected elements. **Justify your answer.** (1 point)