Neuroengineering 2023-2024

June 4th 2024

Part II - Even

How to submit your answers.

The answers can be typed in the Exam.net editor.
Write the answers in the same sequence as the questions (A1, A2, …) and write the same headers as the test on a separate line just above your answer, e.g.:

> Problem
> A1
> *<your answer to question A1 goes here>*
> A2
> *<your answer to question A2 goes here>*
> …

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.

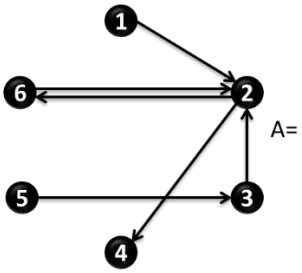
The maximum total score for part II is **8**.

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

A patient needs to undergo **brain surgery** because she has frequent (daily) epileptic seizures that fail to respond to any antiepileptic medications (pharmacoresistant epilepsy). Before and after the intervention, when her skull has to be open to perform the surgery, her **neuroelectrical data** are collected **for several hours.**

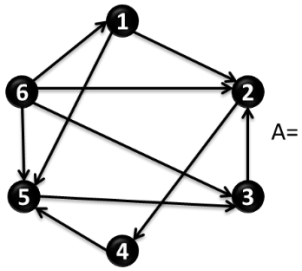
The aim is to build **directed brain functional networks**, to quantify the **role of specific regions** and to compare **the brain network properties before and after the surgery**.

The regions to be monitored are all subcortical. Their behavior at rest is known to occur in **Theta and Alpha bands**.



A=

-	0	0	0	0	0
1	-	1	0	0	1
0	0	-	0	1	0
0	1	0	-	0	0
0	0	0	0	-	0
0	1	0	0	0	-



A=

-	0	0	0	0	1
1	-	1	0	0	1
0	0	-	0	1	1
0	1	0	-	0	0
1	0	0	1	-	1
0	0	0	0	0	-

Fig. 1: Graphs obtained for the patient before (Pre, first row) and after (Post, second row) the brain surgery

Questions: *(write ALL your answer in the exam.net editor)*

Q1. Indicate which **level of invasiveness** and **EEG method** you would choose to the study's purposes and **why**. *(2 point)*

Q2. Indicate which **connectivity estimator** (among those studied in the course) would be more appropriate to the purposes of the study. **Justify your choice.** Indicate **the pros and cons** of this estimator. *(3 points)*

Q3 – Assuming that the analysis returns the functional networks and the corresponding adjacency matrices reported in **Fig. 1:**

Q3.1: Compute the network **Density** for each graph (Pre and Post conditions) *(1 point)*

Q3.2: Compute the **In-degree and the Out-degree** for each node and for each graph (Pre and Post conditions) *(1 point)*

Q3.3: Comparing the Density and the Degrees in the Pre and Post conditions, describe how the network changed after the surgery. *(1 point)*

(End of the test)