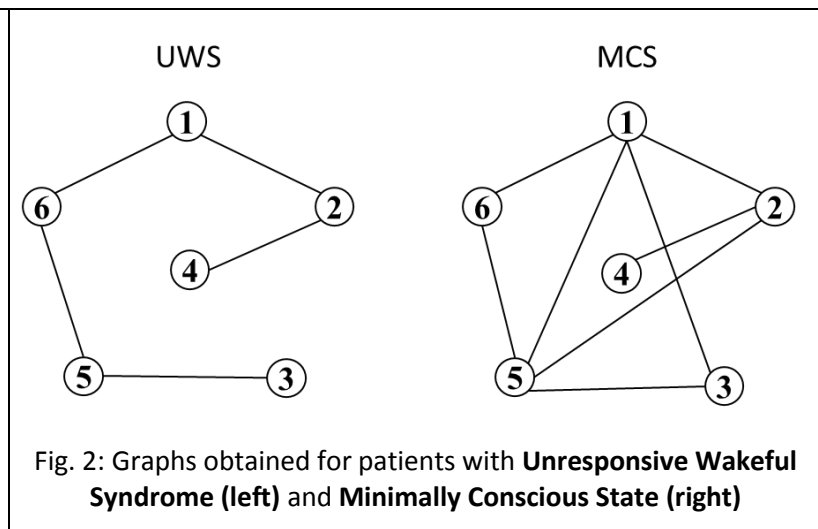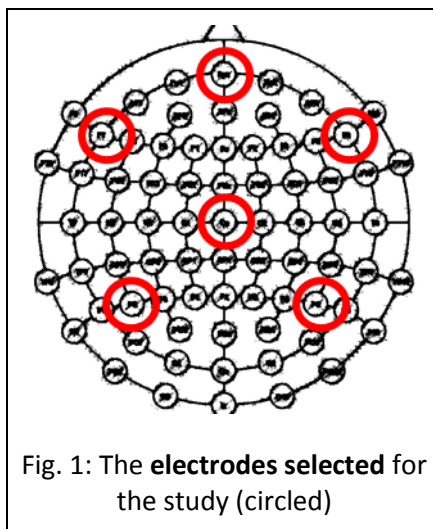## June 18th, 2021 – Part II

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

A study aims to define objective measures of the **brain networks' structure** to be used in support of the diagnosis of a **disorder of consciousness (DoC)**. A group of patients with a diagnosis of **Minimally Conscious State (MCS)** or **Unresponsive Wakefulness Syndrome (UWS, previously known as Vegetative State)** undergo a **64-channels scalp EEG** screening during the **resting state**.

To avoid stress and fatigue to the patients, **a limited amount of trials** is collected.

Hypothesis: it is known that the peculiar brain organization for these patients is coded at **specific frequency bands** (Delta, Theta).

The goal of the study is to **compare the properties** of the brain networks of patients belonging to the two groups, to define new indices to be used in support of the **correct diagnosis** of the patients' conditions.

Fig. 1: The **electrodes selected** for the study (circled)

Fig. 2: Graphs obtained for patients with **Unresponsive Wakeful Syndrome (left)** and **Minimally Conscious State (right)**

Questions

Q1 – Considering the limited amount of trials available and the study's hypothesis, indicate **which connectivity estimator** you would use to perform the **network analysis**. **Motivate your choice**. *(4 points)*

(write the answers in the exam.net editor)

Q2 – Assuming that the network analysis is performed on the **subset of electrodes** reported in **Fig. 1**, and that it returns the two networks reported in **Fig. 2** for UWS and MCS patients, respectively:
    Q2.1: Extract the corresponding **adjacency matrices** *(1 point)*
    Q2.2: Compute the **Degree** for each node and the **Average Degree** for each network *(1 point)*
    Q2.3: Compute the **Density** for each graph *(1 point)*
    Q2.4: Compute the **Global Efficiency** for each graph *(2 points)*

(write the answers on paper)

Q3 – The Average Degree, the Density and the Global Efficiency computed for each patient are later used to classify them in two groups. The rate of correct classifications (in terms of **true positives** and **false positives**) is reported in a **ROC curve** for each index, with:

- AUC = 0.6 for the Average Degree
- AUC = 0.6 for the Density
- AUC = 0.95 for the Global Efficiency

Indicate which of the three indices you would select as a measure to support the diagnosis of MCS/UWS and **why**. *(2 points)*

(write the answers in the exam.net editor)