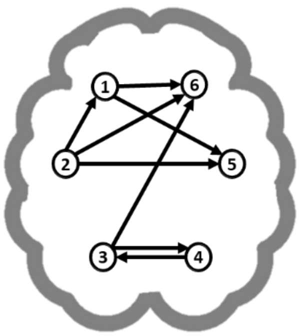
Neuroengineering 2023-2024

July 3th 2024 Part II even

Solutions

Q1:



A=

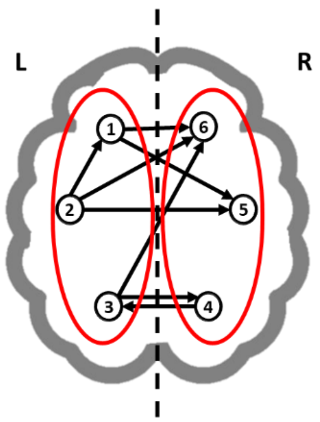
g_{OUT} \ g_{IN}	1	0	1	1	2	3
2	0	0	0	0	1	1
3	1	0	0	0	1	1
2	0	0	0	1	0	1
1	0	0	1	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

$L = 8$

$N = 6$

$$Density: k = \frac{L}{N(N-1)} = \frac{8}{6(6-1)} = 0.27$$

Q2:



A=

0	0	0	0	1	1	1
1	0	0	0	1	1	1
0	0	0	1	0	1	1
0	0	1	0	0	0	2
0	0	0	0	0	0	2
0	0	0	0	0	0	2
1	1	1	2	2	2	

$N = 6$

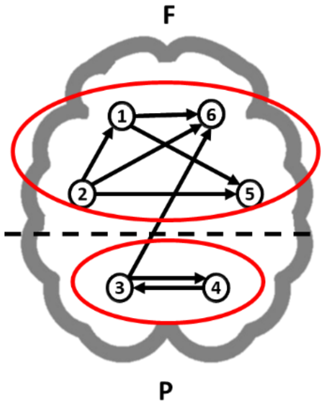
$L = 8$

$C=[1\ 1\ 1\ 2\ 2\ 2]$

$$D = \frac{L}{L + \sum_{i,j=1}^{N} a_{ij}\left[1 - \delta\left(C_i, C_j\right)\right]}$$

$$D = \frac{8}{8+7} = \mathbf{0.53} \qquad D \in [0.5, 1]$$

Q3:



$$A=\begin{array}{|c|c|c|c|c|c|c}
\hline
0 & 0 & 0 & 0 & 1 & 1 & 1 \\
\hline
1 & 0 & 0 & 0 & 1 & 1 & 1 \\
\hline
0 & 0 & 0 & 1 & 0 & 1 & 2 \\
\hline
0 & 0 & 1 & 0 & 0 & 0 & 2 \\
\hline
0 & 0 & 0 & 0 & 0 & 0 & 1 \\
\hline
0 & 0 & 0 & 0 & 0 & 0 & 1 \\
\hline
1 & 1 & 2 & 2 & 1 & 1 & \\
\hline
\end{array}$$

$N = 6$
$L = 8$
$C=[1\ 1\ 2\ 2\ 1\ 1]$

$$D = \frac{L}{L + \sum_{i,j=1}^{N} a_{ij}\left[1 - \delta\left(C_i, C_j\right)\right]}$$

$$D = \frac{8}{8+1} = \mathbf{0}.89 \qquad D \in [0.5, 1]$$

Q4: The results obtained for Q2 and Q3 show an increase in divisibility for the fronto-parietal classes with respect to the left-right hemispheres. In particular, L-R shows a divisibility close to its minimum value (=0.5), while F-P shows a divisibility close to its maximum (=1). Divisibility is a measure of segregation between the classes, quantifying how easy it is to separate the two subnetworks (as an inverse proportion between the links among the classes and the total amount of links in the network). An increase in this index, therefore, indicates that the two classes are more segregated in the fronto-parietal division than in the left-right one. However, no conclusion about the general integration of the network can be drawn from this single index, since: 1) to test whether the two classes act as modules, i.e. are more internally organized than an average group of nodes randomly selected in the network, we would need the to compute the modularity (not requested here) and 2) to quantify the general organization of the network we would need to compute the Global and Local Efficiencies.