Statistical Connectomics: Homework 6

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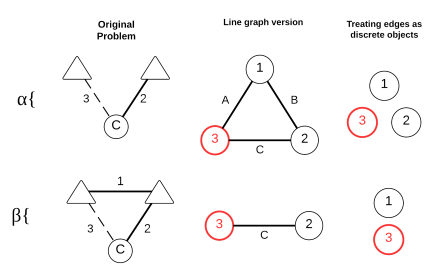
1 Introduction

Fino and Yuste defined in their 2011 paper the problem of whether the existence of a connection between a sGFP neuron with a pyramidal neuron was affected by the existence of an edge between two pyramidal neurons.

2 Outline of the problem

We've been posed the question of whether the probability of existence of edge 3 given edge 1 *P(α)*, is the same as the probability of edge 3 given 1 and 2 *P(β)* (Figure 1,a).

Another way to see this problem is to work with the line graph of the original graph, that is, redefining the edges as nodes ans the nodes and edges.In this case, the question would be if 3 is as likely to exist when 1 exists as when 1 and 2 exist (Figure 1,b).



The null hypothesis we're testing is H_0: P(α) = P(β).

For the discrete object case, we can treat the problem using a Conditional Probability approach by redefining edges 1, 2 and 3 as 'events' that depend on each other. In such a case, the question would be if P(3—1)=P(3—1,2).

where P(3—1)=$\frac{P(3\cap 1)}{P(1)}$ and P(3—1,2)=$\frac{P(3\cap 1\cap 2)}{P(1)P(2)}$

and maybe take the P values from a given probability matrix?

In the case we were using the original problem, we could use the probability of case α and case β happening by computing the

3 Possible Solutions, maybe?

3.1 Probability of Edge Existence Based on Degree Distribution

$$p_{ij} = \sum_{\substack{1 \le s \le d_i \\ 1 \le t \le d_j}} Pr[I_{st,ij} = 1] = d_i d_j Pr[I_{11,ij} = 1]$$

3.2 Compliment of Probability that All Paths Do Not Exist

$$l_{ij}^k = 1 - \prod_{k=1}^{n} (1 - l_{ik}^{k-l} l_{kj})$$

3.3 Cayley's Formula

$$n^{n-2}$$

References

1. Yezekael Hayel, Emma Hart, Eitan Altman, Rachid El-Azouzi, Iacopo Carrera; Bioinspired Models of Network, Information, and Computing Systems: 4th edition

2. S. Sitharama Iyengar, Richard R. Brooks; Distributed Sensor Networks, Second Edition: Sensor Networking and Applications