建構大腦的谷歌地圖

Building a Goggle Map of the Brain

Life is a form of information flow carried by DNA that can be passed from one generation to the next or executed by neural activities in the brains within and between individuals. Billions of brain neurons carry the same genetic information, but the instructions are read out differently in each cell type. At the start of the last century, Santiago Ramon Y Cajal illustrated a remarkable diversity of neurons with Golgi heavy-metal staining under the microscope. Through thousands of painstaking drawing, Cajal showed that the brain is composed of billions of cells with diverse size, shape and interconnection. Yet, more than a hundred years later, we still know little about how many cells types form the human brain, what genes express in each cell, where and when they communicate with each other. This is about to change, thanks to a series of recent breakthrough in new technologies ranging from DNA sequencing and editing, microscopic spatiotemporal imaging, and AI computing. The brain constantly surveys our internal and external environments by taking in information from sensory neurons. To understand how the brain processes information and orchestrates human behaviors, scientists are racing to reconstruct complete wiring diagrams called “connectomes” that map all neural connections in the brain and body.

Taking *Drosophila melanogaster* as an example, I will discuss challenges in building whole-body connectomes and how that knowledge may help us to map human brain for better understanding its normal function and developing cures for mental disorders. Upon the establishment of a Goggle map of brain connectivity, I envision that principles of circuit operation underlying connectome to govern complex behaviors can be deduced by graphic AI computing. The predicted mechanisms transforming a flow of activity into a specific task can be validated by the spatiotemporal manipulations of gene expressions and neuronal activities such as thermogenetic breakers and optogenetic operators. I believe that connectomics AI seeking to mimic nervous systems is the future to expand AI beyond its narrow tasks to a more general use of intelligence.

延伸閱讀

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10 questions for students:

1. What is the effect of Golgi staining?
2. What is optical tissue clearing?
3. What is STS microscopy?
4. What is superresolution microscopy?
5. What is light-sheet microscopy?
6. What is connectomics AI?
7. What is thermogenetics?
8. What is optogenetics?
9. What is The Brain Initiative project?
10. What is Human Cell Atlas project?