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[招待論文] Molecular Networks vs. Neuronal Networks: The Memory Match

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Abstract How are memories stored? In computers it is easy to point to disk/RAM as the site of memory storage, and to the CPU for information processing. In the brain, memories and processing are intermingled. One way to subdivide the two roles is to say that electrical activity in neurons leads to information processing, and the connections (synapses) between neurons store information. Within the synapses, there are complex molecular networks that can form bistable switches and other memory storage circuits. Thus, this viewpoint suggests that we have molecular networks for information storage, and neural networks for information processing.

It is common for neuroscientists to think mostly of neuronal networks, as these are more accessible to the electrophysiological and anatomical tools of the field. Similarly, it is common for systems biologists to think of the chemical networks and discount electrical effects. Unfortunately these two viewpoints often suffer from an impedance mismatch, which would be disastrous if it affected brain function.

In this talk I will discuss some glimpses of how the two kinds of networks interface with each other. I will briefly introduce their typical roles in information processing and memory storage, respectively. I will suggest that rather than being distinct like in a computer, the information processing and memory functions are tightly coupled. Neural networks carry out some levels of memory storage, whereas biochemical networks carry out some forms of computation. Finally, I will illustrate a case where a bistable switch forms out of the coordinated activity in the two kinds of networks, showing that the distinction between networks is misleading, and that they actually are perfectly matched.