

Information, Computation and Linguistic System

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Since the advent of molecular biology, it has been said that cell is a kind of 'machine', which stores its specification inside itself. Although the perspective of systems biology derived from this understanding well prevails, we still do not have a clue to address cellular system deductively, due to the lack of mathematical insights into the system. Here, I propose a conceptual framework where it is possible to abstract the essential features of the system and project them onto the purely mathematical problem. The framework mainly includes the following three concepts; information, computation, and linguistic system. Each concept can be understood independently with explaining specific features inherent to biological system. Nonetheless, the intersection of these concepts can provide us with the fertile results to understand their relationship and hierarchy. In this framework, 4 bases (A, T, G, C) in biology correspond to symbols in information theory and it enables us to discuss probability of occurrence of each symbols, channel capacity and entropies. The DNA-protein interaction, which is one of the most important chemical reactions within cells, corresponds to computation in automata theory, which leads to the understanding of genome as formal languages. What the molecular interactions (cascades, pathways, protein complexes and so forth) correspond in the framework is linguistic system, which I introduce as a definitely new concept in order to explain the interaction between matured components. The apparent discrepancies among those three concepts can be solved by mathematical explanation. Long-standing questions like whether viruses are to be categorized into life or not will be shed light on by viewing them as a mere set of strings which do not have a function of computation. In this paper, I aim at explaining biological system from the perspective, which is completely different from the previous ones.