Molecular Computation of Multimodal Pattern Learning based on the Hypernetwork Model

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abstract

Recent researches in molecular computation suggest that nucleic acids can be used for modeling cognitive learning systems [1, 2]. Here we propose a DNA computing method of learning significant patterns from multiple modalities of data based on a hypernetwork architecture [3]. We suggest a more brain-like learning algorithm based on a distributed and overlapping representation, which can be implemented using the stochastic behavior of DNA molecules. Moreover, the self-assembling property of DNA molecules facilitates the simulation of massive interactions between large population of data during the learning process. In this work, we present that the iterative cycles of perception, prediction and feedback induce gradational evolution of significant patterns of data in the hypernetwork. In our computational simulation, we trained a hypernetwork on a multimodal dataset consisting of handwritten digit images and digit speech sounds. The result of classification showed that the trained hypernetwork can successfully recognize meaningful patterns of data and can generate proper image from speech sound.

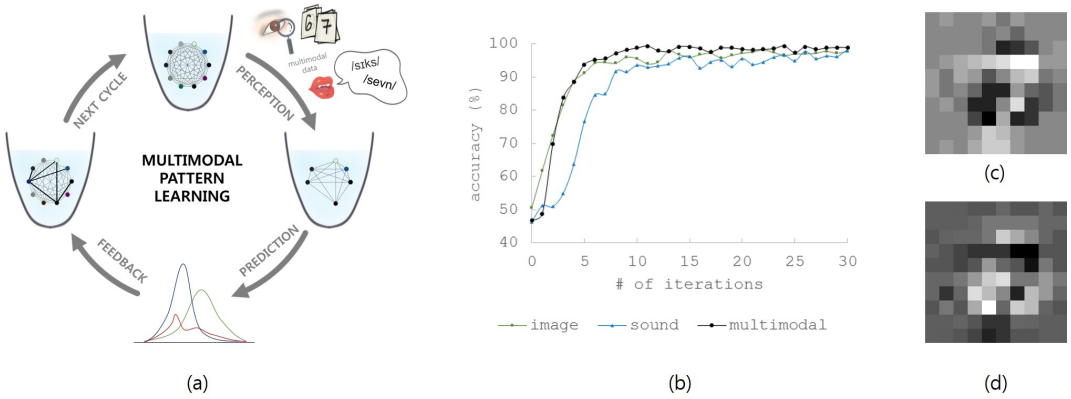

Figure 1: (a) Overview of multimodal pattern learning algorithm (b) classification accuracies during training with multimodal data (c) generated image from the speech sound "6" after training (d) generated image from the speech sound "7" after training

References

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[3] B.-T. Zhang, "Hypernetworks: a molecular evolutionary architecture for cognitive learning and memory," *Computational Intelligence Magazine*, vol. 3, no. 3, pp. 49–63, 2008.

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