Computation or Weight Adaptation? Rethinking the Role of Plasticity in Learning

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Abstract

The human brain can rapidly adapt to new tasks and environments, a capacity traditionally attributed to structural changes in the learning system, such as neural plasticity. Here, we revisit this assumption by asking whether adaptive behavior can emerge through computation alone, without parameter updates. Using large language models (LLMs), we examine statistical learning paradigms that require identifying regularities in arbitrary word sequences and are commonly considered to depend on plasticity. We show that LLMs can acquire such structure through in-context exposure, capturing the underlying regularities without weight adaptation, despite the divergence of these tasks from their natural language training data. These findings suggest that sufficiently trained learning systems may exhibit a greater degree of flexibility through computation than previously acknowledged, and highlight the potential of deep learning models as tools for generating hypotheses about learning mechanisms in the brain.[1]

Keywords: learning; plasticity; computation; statistical learning; in-context learning; large language models.

[1]Code and data are available in this Google Colab notebook.

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