Frontier of Artificial Network

Department of Data Science
香港城市大學
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Neural Networks as a Discretization of Dynamical Systems

Invited Speaker
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Biography

Yongqiang Cai received his PhD in numerical mathematics from Peking University in 2017. He was a postdoctoral fellow at the Faculty of Science, National University of Singapore from 2017 to 2020. He joined the School of Mathematical Sciences of Beijing Normal University in 2020. His research interests include polymer self-assembly, numerical simulations of liquid crystalline bilayers, and the theory, algorithms, and applications of deep learning.

Abstract

Deep learning has made significant progress in data science and natural science. Some studies have linked deep neural networks to dynamical systems, but the network structure is restricted to residual networks. It is known that residual networks can be regarded as numerical discretizations of dynamical systems. In this talk, we consider traditional network structures and prove that vanilla feedforward networks can also be used for the numerical discretization of dynamical systems, where the width of the network is equal to the input and output dimensions. The proof is based on the properties of the leaky-ReLU function and the numerical technique of the splitting method for solving differential equations. The results could provide a new perspective for understanding the approximation properties of feedforward neural networks. In particular, the minimum width of neural networks and the minimal control family of dynamical systems for universal approximation can be derived. In addition, the relationship between mapping compositions and regular languages can be established.