Universität Konstanz

Learning Dynamic Processes with Reservoir Computing

A talk by Prof. Lyudmila Grigoryeva, University of St.Gallen
as part of the interdisciplinary network platform
Connecting Statistical Logic, Dynamical Systems and Optimization.

Tuesday, 4th June 2024, 13:30 – 15:00 in G309

Abstract Many dynamic problems in engineering, control theory, signal processing, time series analysis, and forecasting can be described using input/output (IO) systems. Whenever a true functional IO relation cannot be derived from first principles, parsimonious and computationally efficient state-space systems can be used as universal approximants. We have shown that Reservoir Computing (RC) state-space systems with simple and easy-to-implement architectures enjoy universal approximation properties proved in different setups. The defining feature of RC systems is that some components (usually the state map) are randomly generated, and the observation equation is of a tractable form. From the machine learning perspective, RC systems can be seen as recurrent neural networks with random weights and a simple-to-train readout layer (often a linear map). RC systems serve as efficient, randomized, online computational tools for learning dynamic processes and enjoy generalization properties that can be explicitly derived. We will make a general introduction to up-to-date theoretical developments, discuss connections with research contributions in other fields, and address details of RC systems' applications.

https://www.math.uni-konstanz.de/algebra/network_platform_cs_math/