Department of Mathematical Sciences

Fall 2019

Colloquium Series

December 12, 2019 at 3pm in Bell Hall 143
(Note the unusual day)

Candidate for Data Science Faculty Position

Dr. Lyudmila Grigoryeva

Universität Konstanz, Germany

Reservoir Based Machine Learning of Dynamic Processes

A relatively recent family of dynamic machine learning paradigms known collectively as reservoir computing (RC) is presented which is capable of unprecedented performances in the forecasting of deterministic and stochastic processes. We then focus on the universal approximation properties with respect to L^{∞}-type criteria of the most widely used families of reservoir systems. These results are a much awaited generalization to the dynamic context of previous well-known static results obtained in the context of neural networks. It is proved that linear reservoir systems with either polynomial or neural network readout maps are universal, and, more importantly, the same property holds for two families with linear readouts, namely, state-affine systems and echo state networks. We complement the universality results with high-probability generalization error bounds computed explicitly. The linearity in the readouts is a key feature in supervised machine learning applications. It guarantees that these systems can be used in high-dimensional situations and in the presence of large datasets. We assess empirically the performance of RC systems in applications to time series forecasting. In particular, we focus on predicting financial realized variance matrices which is a question of much importance for practitioners and researchers. We conclude the presentation outlining the work in progress and future lines of research.

For further information, please contact
Dr. Ori Rosen, orosen@utep.edu

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