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Title: Forecasting Space Weather with Symbolics Dynamics and Machine Learning

The development of early warning systems and extension of forecasting time is a critical demand for real-world applications, such as extreme space weather originating in solar flares, coronal mass ejections, and other solar phenomena. Long Short Term Memory networks (LSTMs) are a type of recurrent neural network (RNN), capable of realizing long-term dependencies. LSTMs are purposefully designed to avoid the long-term dependency problem and do not rely on specific assumptions about the data such as time series stationarity. This makes them potentially useful for the study of physical problems where persistence is a clear feature of the nonstationary data, such as extreme space weather. In this paper we apply the PyTorch machine learning framework to study the global magnetic storm index Dst, the strongest metric of space weather. As input we include a previously developed complexity measure based on symbolic dynamics. The measure representation algorithm decreases the computational burden and makes it possible to directly compare statistical properties of the model and the multifractal complexity measure produced from Dst. Next, we apply LSTMs to extend previous space weather forecasting methods.