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Commentary

Brief Note on the Machine Learning Systems

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COMMENTARY

This study aims to identify various chaotic systems by classify graphic pictures of their time series using deep learning techniques for the first time in the literature. To achieve this, a data collection made up of the graphical representations of time series for the three most well-known chaotic systems are the Lorenz, Chen, and Rossler systems. Different parameter values, initial circumstances, step sizes, and period lengths are used to obtain the time series. After creating the data set, the transfer learning approach is used to accomplish a high-accuracy classification. The study makes use of the most widely used transfer learning methodologies' deep learning models. Squeeze Net, VGG-19, Alex Net, ResNet50, ResNet101, DenseNet201, Shuffle Net, and Google Net are some examples of these models.

According to the study findings, classification accuracy ranges from 96% to 97% depending on the issue. The coupling of real-time random signals with a mathematical system is thus made possible by this study. Non-linear mathematical models called chaotic systems are used to describe chaotic behavior. Alternatively put, chaotic systems are nonlinear systems that behave chaotically. Recent years have seen the usage of chaotic systems in a wide range of engineering fields, including DC-DC converters, DC image converters, image and audio encryption, secure communication, data security, random number generation, and digital signature applications. Deep learning has gained popularity in recent years as well.

There are many studies on deep learning, but the majority of these studies concentrate on categorization methods used in many fields. In this study, chaos and deep learning-two of the literature's most popular topics-are highlighted and time series of chaotic systems are categorized using deep learning. Deep learning is a form of machine learning that applies multi-layer artificial neural networks to a variety of tasks, including object detection, speech recognition, and natural language processing. Deep learning differs from conventional machine learning algorithms in that it enables automatic learning from a database (including picture, audio, and video) as opposed to the use of predetermined rules.

As far as the author is aware, there hasn't been any research on classifying chaotic system photos using deep learning.

However, there are researches that classify chaotic systems from signals using deep learning that are documented in the literature. They classified time series of discrete and continuous time dynamic systems in their study using ShallowNet, Multilayer Perceptrons (MLP), Fully Convolutional Neural networks (FCN), Residual Networks (ResNet), and Large Kernel Convolutional Neural Networks (LKCNN). They claimed that the LKCNN method produces the best classification results. He came to the conclusion that LSTM effectively filters out noise to accurately forecast nonlinear dynamics.

To predict time series of Lorenz and Henon map chaotic systems, Deep Belief Nets (DBNs) using Restricted Boltzmann Machines (RBM) and Multi-Layer Perceptrons (MLP) are proposed. They demonstrated that their suggested DBNs have higher prediction sensitivity than conventional DBNs. Compared the four models they proposed for fidelity and prediction accuracy (namely, FF-recursive, FF-multi-output, LSTM-TF and LSTM-no-TF). These models are based on the teacher-forcing and feed forward educational models, as well as recurrent neural networks of synthetic chaotic oscillator time series with no noise. They demonstrate that LSTM predictor outperforms FF-recursive and FF-multi-output approaches in terms of results.

As can be seen from the aforementioned works, classification of chaotic systems over graphic images is absent, whilst there is a dearth of research on deep learning-based classification of chaotic signals. However, it is believed that categorization of chaotic behaviors or random signals are necessary. To answer the aforementioned need, a method to categories time series of chaotic systems based on transfer learning methods SqueezeNet, VGG-19, AlexNet, ResNet50, ResNet101, DenseNet201, ShuffleNet, and GoogLeNet is described in this paper. For the first time in the literature, a unique study is provided by accurately classifying time series of two separate chaotic systems.

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