Prediction of Hurricane Paths through Neural Networks

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Abstract

•Background and purpose: Studies suggest that there are alternative methods to precisely predict hurricane trajectories. We examined past hurricanes to determine a pattern and cross-reference these neural-networks to create a new system of predicting through coding via python.

•Methods: Information was gathered from the past 20 years in the panhandle area of Florida. We observed and analyzed hurricane hits and considered wind patterns on the date and location of the event. Data was also gathered from each big hurricane that happened in the area specifically from the past 10 years such as Hurricane Michael and Irma. Information being collected is later converted into data points to develop a pattern including the date of landfall, the strength of the hurricane, diameter, etc.

•Results: Not yet determined (still in progress).

•Conclusions: In progress. Idea is that when peers are done implementing perception in regard to the hurricane trajectories through the python coding system, we can try different algorithms and begin to input data points from past hurricane events.

Introduction

•This study aims to understand the parameters of how to feed a neural network– provides a transformation of the input into the desired output.

•More specifically, the purpose of this study is to define the parameters that can be (sub)optimally used to feed an artificial neural-network–a self-correcting algorithm– and eventually predict hurricane trajectories post-landfall.

•Historical hurricane data will be feed into a multilayer perceptron and will use an algorithm associated with backpropagation or recurrent neural networks.

•Despite the development of multiple methods that can successfully predict hurricane intensity, less research has been done on ways to predict the track of hurricane events after landfall.

•This is a descriptive study because we are observing past historical hurricane events and their respective trajectories rather than manipulating some sort of variable.

•The historical data is information from the past 100 years of hurricanes that have made landfall in the Atlantic ocean.

•The main language that will use to form the perceptron is Python, a high-level programming language.

Methods

Sample Table 1: Hurricane data From 2020 From the HURDAT Format Data set

Dates	Hours	Landfall	Status Of System	Latitude	Longitude	Wind speed	Pressure
09/21/20	0		TS	27.5N	94.1W	50	993
09/21/20	600		TS	27.6N	94.8W	45	995
09/21/20	1200		TS	27.8N	95.5W	45	997
09/21/20	1800		TS	28.1N	96.0W	40	999
09/21/20	0		TS	28.3N	96.3W	45	998
09/22/20	245	L	TS	28.4N	96.4W	45	997
09/22/20	600		TS	28.6N	96.6W	40	999
09/22/20	1200		TS	28.8N	96.8W	35	1002
09/22/20	1800		TD	28.9N	96.5W	25	1006

•The experimental equipment needed to conduct the study is a set of deep learning algorithms written in Python and several databases as well as the HURDAT format to conduct research and explain specific components of the data specifically from past hurricanes recorded through the National Hurricane Center and Central Pacific Hurricane Center.

•The research group analyzes the hypothesis of being able to predict non-discrete and non-probabilistic events using Black Box–a scientific learning model machine–supervised and unsupervised training schemes.

•Machine learning algorithms will be implemented in two main structures: Back Propagation and Recurrent.

•Historic Data collected is organized by: Date, Time, Status, Longitude and Latitude, then Maximum Sustained Winds, and Minimum System Pressure. Data can be seen in Figure 2.

•Because we are predicting trajectory, the primary data for this research will focus on hurricanes that made landfall in the Atlantic. We will be using a 6-hour time interval for the records of the hurricane movements, starting with midnight.

•We will be using at least 37 hurricane hits or hurricane events to train our neural network, starting from 1983 to 2020. To have an accurate calculation, the hurricane event must have at least 8 records before and 4 records after it reached landfall.

Results

•Formatted results are still in the process of being collected; however, implementation of a recurrent neural network has begun, and the machine learning algorithm is in progress.

•There has been implementation for the two algorithms for building a multilayer perceptron with historical data.

•The backpropagation has proven to be a bit more complex than the recurrent neural network algorithm

•Data input is finally starting to advance, and distinctions have been formed rather than individual input data.

Discussion

The ability for a multilayer perceptron being able to track the trajectory of a hurricane is still in progress. There is still more testing to determine how we can use the backpropagation algorithm and recurring neural networks to form predictions through machine learning. We may switch to fixed values instead. For now, we examining the weights formed by the machine learning for each of the components. For example, the wind and pressure are weighted heavily in the predictions of the perceptron. As more information is discovered more data points are created as inputs. Updating Python is crucial to the study considering the goal is to create a better model system than those that exist now.

Conclusion

•As machine learning advances, over time programs using perceptron's will be able to assess predictions about natural factors that influence natural disasters such as hurricane trajectory.

•Knowing the precursors to environmental factors leading to hurricane development would allow future scientists to predict these storms much further in advance.

•Through trial and error and deep analysis of past hurricane events specifically from the past 20 years, it will hopefully be possible to devise the new system.

•Before being released for certified use, the system still has a long way to go. Much needs to be tested to ensure minimal percent error and maximize the benefits of an accurate model.

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